Nokia Customer Care

Service Manual

RM-333; RM-334 (Nokia N85; L3&4)

Mobile Terminal

Part No: (Issue 1)

COMPANY CONFIDENTIAL

Amendment Record Sheet

Amendment No	Date	Inserted By	Comments
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IMPORTANT

This document is intended for use by qualified service personnel only.

Warnings and cautions

Warnings

- IF THE DEVICE CAN BE INSTALLED IN A VEHICLE, CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI-SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/ MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
- THE PRODUCT MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES, FOR EXAMPLE, PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
- OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. CONSULT A PHYSICIAN OR THE MANUFACTURER OF THE MEDICAL DEVICE IF YOU HAVE ANY QUESTIONS. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.
- BEFORE MAKING ANY TEST CONNECTIONS, MAKE SURE YOU HAVE SWITCHED OFF ALL EQUIPMENT.

Cautions

- Servicing and alignment must be undertaken by qualified personnel only.
- Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
- Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
- Use only approved components as specified in the parts list.
- Ensure all components, modules, screws and insulators are correctly re-fitted after servicing and alignment.
- Ensure all cables and wires are repositioned correctly.
- Never test a mobile phone WCDMA transmitter with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.
- During testing never activate the GSM or WCDMA transmitter without a proper antenna load, otherwise GSM or WCDMA PA may be damaged.

ESD protection

Nokia requires that service points have sufficient ESD protection (against static electricity) when servicing the phone.

Any product of which the covers are removed must be handled with ESD protection. The SIM card can be replaced without ESD protection if the product is otherwise ready for use.

To replace the covers ESD protection must be applied.

All electronic parts of the product are susceptible to ESD. Resistors, too, can be damaged by static electricity discharge.

All ESD sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD protected spare part packages MUST NOT be opened/closed out of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local Nokia After Market Services representative.

Care and maintenance

This product is of superior design and craftsmanship and should be treated with care. The suggestions below will help you to fulfil any warranty obligations and to enjoy this product for many years.

- Keep the phone and all its parts and accessories out of the reach of small children.
- Keep the phone dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the phone in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the phone in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the phone in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the phone. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the phone.
- Do not paint the phone. Paint can clog the moving parts and prevent proper operation.
- Use only the supplied or an approved replacement antenna. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, battery, charger or any accessory.

Company policy

Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, NOKIA MOBILE PHONES Business Group should be notified in writing/e-mail.

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- Latest Amendment Number (if applicable)
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Battery information

Note: A new battery's full performance is achieved only after two or three complete charge and discharge cycles!

The battery can be charged and discharged hundreds of times but it will eventually wear out. When the operating time (talk-time and standby time) is noticeably shorter than normal, it is time to buy a new battery.

Use only batteries approved by the phone manufacturer and recharge the battery only with the chargers approved by the manufacturer. Unplug the charger when not in use. Do not leave the battery connected to a charger for longer than a week, since overcharging may shorten its lifetime. If left unused a fully charged battery will discharge itself over time.

Temperature extremes can affect the ability of your battery to charge.

For good operation times with Li-Ion batteries, discharge the battery from time to time by leaving the product switched on until it turns itself off (or by using the battery discharge facility of any approved accessory available for the product). Do not attempt to discharge the battery by any other means.

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

Do not short-circuit the battery. Accidental short-circuiting can occur when a metallic object (coin, clip or pen) causes direct connection of the + and - terminals of the battery (metal strips on the battery) for example when you carry a spare battery in your pocket or purse. Short-circuiting the terminals may damage the battery or the connecting object.

Leaving the battery in hot or cold places, such as in a closed car in summer or winter conditions, will reduce the capacity and lifetime of the battery. Always try to keep the battery between 15°C and 25°C (59°F and 77°F). A phone with a hot or cold battery may temporarily not work, even when the battery is fully charged. Batteries' performance is particularly limited in temperatures well below freezing.

Do not dispose of batteries in a fire!

Dispose of batteries according to local regulations (e.g. recycling). Do not dispose as household waste.

Nokia N85; L3&4 Service Manual Structure

1 General Information
2 Service Tools and Service Concepts
3 BB Troubleshooting
4 RF Troubleshooting
5 Camera Module Troubleshooting
6 FMTx 2.1 Technical Description
7 FMTx 2.1 Troubleshooting
8 System Module and User Interface
Glossary

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1 — General Information

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Table of Contents

Product selection 1–5
Product features and sales package 1–5
Mobile enhancements 1–8
Technical Specifications 1–10
    Transceiver general specifications 1–10
    Main RF characteristics for GSM850/900/1800/1900 and WCDMA VIII/II/I phones 1–10
    Main RF characteristics for GSM850/900/1800/1900 and WCDMA V/II/I phones 1–11
    Battery endurance 1–13
    Environmental conditions 1–13

List of Tables

Table 1 Audio 1–8
Table 2 Car 1–9
Table 3 Data 1–9
Table 4 Messaging 1–9
Table 5 Power 1–10

List of Figures

Figure 1 View of RM-333/RM-334 1–5

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Product selection

RM-333 is a dual mode handportable multimedia computer, supporting GSM/GPRS/EGPRS850/900/1800/1900, with WCDMA VIII (900)/ II (1900)/ I (2100) HSDPA and WLAN. RM-334 supports GSM/GPRS/EGPRS850/900/1800/1900, with WCDMA V (850)/ II (1900)/ I (2100) HSDPA and WLAN.

The device is a 3GPP Release 5 terminal supporting WCDMA/HSDPA, EGPRS and GPRS data bearers. For WCDMA HSDPA the maximum bit rate is up to 3.6 Mbps for downlink and 384 kbps for uplink with simultaneous CS speech or CS video (max. 64 kbps).

For 2G and 2.5G networks the device is a Class A EGPRS DTM MSC 11 which means a maximum download speed of up to 296kbit/s with EGPRS, and up to 107kbit/s with GPRS.

According to GSM standard 05.05 it responds to class 4 (max. 2W) in GSM 850 and EGSM 900 class 1 (1W) in DCS 1800 and class 1 in PCS 1900. The device supports EGPRS (EDGE) class B as well as Bluetooth 2.0 EDR standard.

The device supports two way video calls with two integrated cameras, one on the front and one on the back.

The device is an MMS (Multimedia Messaging Service) enabled multimedia computer with a large 2.6’’ QVGA (240 x 320 pixels) TFT colour display capable of displaying 16 million colours and an integrated 5 Megapixel auto focus camera. The MMS implementation follows the OMA MMS standard release 1.2. The Browser is a highly advanced internet browser also capable of viewing operator domain XHTML Mobile Profile (MP) content.

The device uses Symbian 9.3 operating system and supports MIDP Java 2.0 & CLDC1.1, providing a good platform for compelling 3rd party applications.

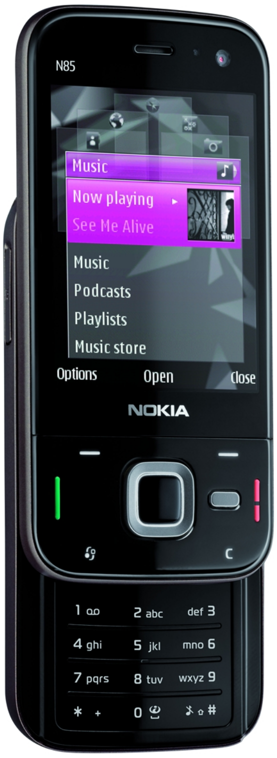

Figure 1 View of RM-333/RM-334

Product features and sales package

Imaging

Main camera:

- Sensor: 5 megapixel
- Carl Zeiss Optics: Tessar™ lens
- F number/Aperture: F2.8
- Focal length: 4.6 mm
  35 mm (35 mm equivalent)
- Focus range: 10 cm ~ infinity
- Macro focus distance: 10-50 cm
- Shutter speed: Mechanical shutter 1/1000~1/4 s

Secondary camera:

- Sensor: CIF (352 x 288 pixels)
- F number/Aperture: F2.8
- Focal length: 43 mm (35mm equivalent)
- Focus range: 10 cm ~ infinity

Video:

- Video resolution: QCIF at 15 fps
- Audio recording: AAC (AMR for MMS)
- Video stabilization
- Video clip length: 60 min
- Video file format: .mp4 (default), .3gp (for MMS)
- White balance: automatic, sunny, cloudy, incandescent, fluorescent
- Scene: Auto, Night
- Colour tone: normal, sepia, B&W, vivid, negative
- Zoom (digital): up to 8x

Photo:

- Still image resolutions: up to 3.2 megapixel: 2048 x 1536
- Still image file format: JPEG/EXIF
- Auto focus
- Auto exposure: center weighted AE
- Image orientation: automatic
- Exposure compensation: +2 ~ -2EV at 0.5 step
- White balance: automatic, sunny, cloudy, incandescent, fluorescent
- Scene: auto, sports, portrait, close-up, landscape, night, user defined
- Colour tone: normal, sepia, B&W, vivid, negative
- Zoom (digital): up to 20x

Other camera features:

- LED flash and recording indicator
- Front camera, CIF (352 x 288) sensor

Edit

- On device Photo editor and Video editor (manual & automatic)

View

- 2.6" QVGA (240 x 320 pixels) 16 million colour TFT display with wide viewing angle and ambient light detector - used to optimize display and keypad backlight brightness and power consumption
- Slideshow from Gallery

Share

- Nokia XpressShare - share effortlessly from Gallery or after capture via Email, Bluetooth, MMS or IrDA
- Direct connection to TV via cable or WLAN (UPnP)
- Video call and video sharing support. (WCDMA services)
- Online Album : Image/Video uploading from Gallery

Print

- Nokia XpressPrint – direct printing via USB (PictBridge), Bluetooth (BPP), and WLAN (UPnP), from memory card or via online printing

Store

- Nokia XpressTransfer – easy to transfer and organize photos and video between your device and a compatible PC
- Nokia Lifeblog (mobile & PC)

Music

- Digital music player: supports MP3/ AAC/ AAC+/ eAAC+/ WMA with playlists, equalizer and album art.
- Synchronise music with Microsoft Windows Media Player 10 & 11
- One click CD ripping, converting and transferring music to your device using Nokia Music Manager
- Stereo FM radio (87.5-108MHz /76-90MHz) with Visual Radio™ support
- Stereo speakers
- Integrated FM transmitter (88.1 – 107.9 MHz)
- Integrated handsfree speaker
- Nokia Stereo Headset (HS-45), in-box

Media

- Full-screen video playback to view downloaded, streamed or recorded video clips
- Supported video formats: MPEG-4 , H.264/AVC, H.263/3GPP, RealVideo 8/9/10

Productivity

Messaging:

- E-mail (SMTP, IMAP4, POP3), MMS, SMS

Office applications:

- Viewing of email attachments – .doc, .xls, .ppt, . pdf

PIM:

- Contacts, calendar, to-do, notes, recorder, calculator, clock, converter

Synchronization:

- Local/Remote (using SyncML)

  - Data: Calendar, Contacts, To-do, Notes, E-mail
  - PC Applications: Microsoft Outlook (98, 2000, 2002, 2003), Outlook Express, Lotus Organizer (5.0, 6.0), Lotus Notes (5.0, 6.0)

Call management:

- Call logs, speed dial, voice dialling (with SIND) and voice commands
- Nokia Push to Talk (PoC)

Connectivity

- WLAN - IEEE802.11 g/b with UPnP support
- Mini USB type B interface with USB 2.0 full speed
- Bluetooth wireless technology 2.0 + EDR
- Nokia 3.5 mm AV connector

Add-on software framework

- Symbian 9.3 OS
- Nokia Series 60, 3rd edition, feature pack 2
- Java: MIDP2.0
- C++ and Java SDKs

Additional technical specifications

- Vibrating alert
- 3GPP Rel 5 WCDMA , Rel 4 EGSM compliant
- Speech codecs supported in WCDMA: AMR
- Speech codecs supported in GSM: FR AMR/HR AMR/EFR/FR/HR
- WCDMA HSDPA with simultaneous voice and packet data (PS max speed DL/UL= 3.6Mbps/384kbps, CS max speed 64kbps)
- Dual Transfer Mode (DTM) support for simultaneous voice and packet data connection in GSM/EDGE networks. Simple class A, multi slot class 11, max speed DL/UL: 118.4/118.4kbits/s
- EGPRS class B, multi slot class 32, (5 Rx + 3 Tx / Max Sum 6), max speed DL/UL= 296 / 177.6 kbits/s
- GPRS class B, multi slot class 32 (5 Rx + 3 Tx / Max Sum 6), max speed DL/UL= 107 / 64.2 kbits/s
- GPS

Sales package

- Transceiver RM-333 or RM-334
- Charger (AC-10)
- Battery (BL-5K)
- Music headset (HS-45/AD-54)
- Connectivity cable (CA-101)

Mobile enhancements

Table 1 Audio

Enhancement	Type
Music headset	HS-45 with AD-45 3.5mm stereo plug

Enhancement	Type
Basic headset	HS-41
Stereo headset	HS-48
Bluetooth headset	BH-101
	BH-201
	BH-208
	BH-600
	BH-604
	BH-800
	BH-801
	BH-803
	BH-900
	BH-903
Mini speaker	MD-6

Table 2 Car

Enhancement	Type
Nokia Universal Holder	CR-99
Car kit	Nokia 616
Multimedia car kit	CK-7W

Table 3 Data

Enhancement	Type
Connectivity cable	CA-101
Video connectivity cable	CA-75U
MicroSD card	MU-28, 512 MB MicroSD Card
	MU-22, 1 GB MicroSD Card
	MU-37, 2 GB MicroSD Card
	MU-41, 4 GB MicroSD Card
	MU-43, 8 GB MicroSD Card

Table 4 Messaging

Enhancement	Type
Wireless keyboard	SU-8W

Table 5 Power

Enhancement	Type
Battery 1200mAh Li-ion	BL-5K
Travel charger	AC-10

Technical Specifications

Transceiver general specifications

Unit	Dimensions (L x W x T) (mm)	Weight (g)	Volume (cm^3)
Transceiver with BL-5K 1200mAh li-ion battery back	103 x 50 x 16.0	126.5	76

Main RF characteristics for GSM850/900/1800/1900 and WCDMA VIII/II/I phones

Parameter	Unit
Cellular system	GSM850, EGSM900, GSM1800/1900, WCDMA VIII (900), WCDMA II (1900) and WCDMA I (2100)
Rx frequency band	GSM850: 869 - 894 MHz
	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
	WCDMA VIII (900): 925- 960 MHz
	WCDMA II (1900): 1930-1990MHz
	WCDMA I (2100): 2110 - 2170 MHz
Tx frequency band	GSM850: 824 - 849 MHz
	EGSM900: 880 - 915 MHz
	GSM1800: 1710 - 1785 MHz
	GSM1900: 1850 - 1910 MHz
	WCDMA VIII (900): 880 - 915 MHz
	WCDMA II (1900): 1850-1910MHz
	WCDMA I (2100): 1920 - 1980 MHz

Parameter	Unit
Output power	GSM850: +5 ...+33dBm/3.2mW ... 2W
	GSM900: +5 ... +33dBm/3.2mW ... 2W
	GSM1800: +0 ... +30dBm/1.0mW ... 1W
	GSM1900: +0 ... +30dBm/1.0mW ... 1W
	WCDMA VIII (900): -50 ... +24 dBm/0.01μW ... 251.2mW
	WCDMA II (1900): -50 ... +24dBm/0.01μW ... 251.2mW
	WCDMA I (2100): -50 ... +24 dBm/0.01μW ... 251.2mW
EDGE output power	EDGE850: +5 ... +29dBm/3.2mW ... 794mW
	EDGE900: +5 ... +29dBm/3.2mW ... 794mW
	EDGE1800: +0 ... +26dBm/1.0mW ... 400mW
	EDGE1900:+0 ... +26dBm/1.0mW ... 400mW
Number of RF channels	GSM850: 124
	GSM900: 174
	GSM1800: 374
	GSM1900: 299
	WCDMA VIII (900): 152
	WCDMA II (1900): 289
	WCDMA I (2100): 277
Channel spacing	200 kHz (WCDMA II 100/200 kHz)
Number of Tx power levels	GSM850: 15
	GSM900: 15
	GSM1800: 16
	GSM1900: 16
	WCDMA VIII (900): 75
	WCDMA II (1900): 75
	WCDMA I (2100): 75

Main RF characteristics for GSM850/900/1800/1900 and WCDMA V/II/I phones

Parameter	Unit
Cellular system	GSM850, EGSM900, GSM1800/1900, WCDMA V (850), WCDMA II (1900) and WCDMA I (2100)

Parameter	Unit
Rx frequency band	GSM850: 869 - 894MHz
	EGSM900: 925 - 960 MHz
	GSM1800: 1805 - 1880 MHz
	GSM1900: 1930 - 1990 MHz
	WCDMA V (850): 869 - 894 MHz
	WCDMA II (1900): 1930 - 1990 MHz
	WCDMA I (2100): 2110 - 2170 MHz
Tx frequency band	GSM850: 824 - 849MHz
	EGSM900: 880 - 915 MHz
	GSM1800: 1710 - 1785 MHz
	GSM1900: 1850 - 1910 MHz
	WCDMA V (850): 824 - 849 MHz
	WCDMA II (1900): 1850 - 1910 MHz
	WCDMA I (2100): 1920 - 1980 MHz
Output power	GSM850: +5 ...+33dBm/3.2mW ... 2W
	GSM900: +5 ... +33dBm/3.2mW ... 2W
	GSM1800: +0 ... +30dBm/1.0mW ... 1W
	GSM1900: +0 ... +30dBm/1.0mW ... 1W
	WCDMA V (850): -50 ... +24 dBm/0.01μW ... 251.2mW
	WCDMA II (1900): -50 ... +24 dBm/0.01μW ... 251.2mW
	WCDMA I (2100): -50 ... +24 dBm/0.01μW ... 251.2mW
EDGE output power	EDGE850: +5 ... +29dBm/3.2mW ... 794mW
	EDGE900: +5 ... +29dBm/3.2mW ... 794mW
	EDGE1800: +0 ... +26dBm/1.0mW ... 400mW
	EDGE1900:+0 ... +26dBm/1.0mW ... 400mW
Number of RF channels	GSM850: 124
	GSM900: 174
	GSM1800: 374
	GSM1900: 299
	WCDMA V (850): 108
	WCDMA II (1900): 289
	WCDMA I (2100): 277
Channel spacing	200 kHz (WCDMA V and II 100/200 kHz)

Parameter	Unit
Number of Tx power levels	GSM850: 15
	GSM900: 15
	GSM1800: 16
	GSM1900: 16
	WCDMA V (850): 75
	WCDMA II (1900): 75
	WCDMA I (2100): 75

Battery endurance

Battery	Capacity (mAh)	Talk time	Stand-by
BL-5K	1200	up to 190 mins (WCDMA) & 260 mins (GSM)	up to 320 hrs (WCDMA) & 320 hrs (GSM)

Charging times

AC-10
1h 30 min

Environmental conditions

Environmental condition	Ambient temperature	Notes
Normal operation	-10 ºC ... +55 ºC	Specifications fulfilled
Reduced performance	55 ºC ... +70 ºC	Operational only for short periods
Intermittent or no operation	-40 ºC ... -15 ºC and +70 ºC ... +85ºC	Operation not guaranteed but an attempt to operate will not damage the phone
No operation or storage	<-40 ºC and >+85 ºC	No storage. An attempt to operate may cause permanent damage
Charging allowed	-15 ºC ... +55 ºC	
Long term storage conditions	0 ºC ... +85 ºC	

Environmental condition	Ambient temperature	Notes
Humidity and water resistance		Relative humidity range is 5 to 95%. Condensed or dripping water may cause intermittent malfunctions. Protection against dripping water has to be implemented in (enclosure) mechanics. Continuous dampness will cause permanent damage to the module.

2 — Service Tools and Service Concepts

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Table of Contents

Service tools 2–5
  Product specific tools 2–5
    FS-73 2–5
    MJ-161 2–6
    RJ-230 2–6
    SA-154 2–6
    SS-100 2–7
    SS-157 2–7
  General tools 2–7
    RJ-166 2–7
    RJ-209 2–7
    RJ-227 2–8
    RJ-93 2–8
    ST-53 2–8
    ST-64 2–8
    ST-70 2–8
  Cables 2–8
    CA-101 2–9
    CA-128RS 2–9
    CA-31D 2–9
    CA-35S 2–9
    PCS-1 2–10
    XCS-1 2–10
    XCS-4 2–10
Service concepts 2–11
  POS (Point of Sale) flash concept 2–11
  Flash concept with FPS-10 2–12
  CU-4 flash concept with FPS-10 2–13
  Flash concept with FPS-10 and SB-6 2–14
  Flash concept with SS-46 and CA-89DS 2–15
  Flash concept with SS-62 and CA-89DS 2–16
  Flash concept with FPS-10, SS-62 and SB-6 2–17
  Flash concept with FPS-10, SS-62 and SB-7 2–18
  Module jig service concept 2–19
  Module jig service concept with SB-6 2–20
  RF testing concept with RF coupler 2–21
  Service concept for RF testing and RF/BB tuning 2–22

List of Figures

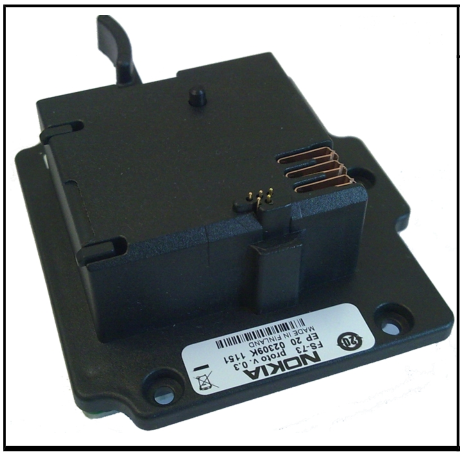
Figure 2 POS flash concept 2–11
Figure 3 Basic flash concept with FPS-10 2–12
Figure 4 CU-4 flash concept with FPS-10 2–13
Figure 5 Flash concept with FPS-10 and SB-6 2–14
Figure 6 Flash concept with SS-46 and CA-89DS 2–15
Figure 7 Flash concept with SS-62 and CA-89DS 2–16
Figure 8 Flash concept with FPS-10, SS-62 and SB-6 2–17
Figure 9 Flash concept with FPS-10, SB-7 and JBT-9 2–18
Figure 10 Module jig service concept 2–19
Figure 11 Module jig service concept with SB-6 2–20

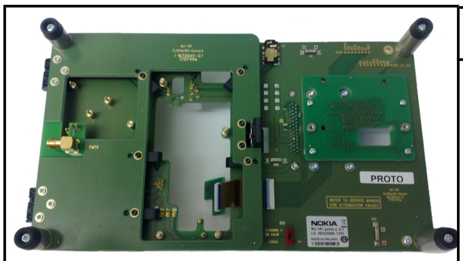
Figure 12 RF testing concept with RF coupler 2–21
Figure 13 Service concept for RF testing and RF/BB tuning 2–22

Service tools

Product specific tools

The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RM-333; RM-334. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

	FS-73	Flash adapter	
	• FS-73 is equipped with a clip interlock system • provides standardised interface towards Control Unit • multiplexing between USB and FBUS media, controlled by VUSB		



MJ-161	Module jig	

MJ-161 is meant for component level troubleshooting.

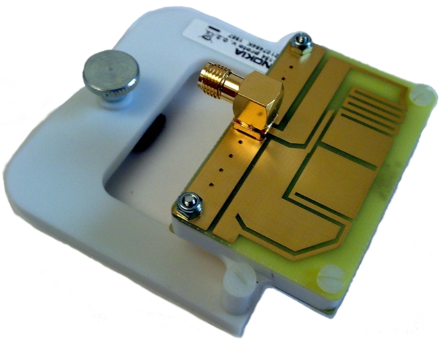
The jig includes RF interface for Bluetooth, WLAN and GPS. In addition, it has the following features:

- Provides mechanical interface with the engine module
- Provides galvanic connection to all needed test pads in module
- Multiplexing between USB and FBUS media, controlled by Vusb
- Connector for control unit
- Access for Audio-, MMC, and USB connectors
- **Module jig attenuation values:**

Band	F	Attenuation
GSM850 TX	824-849	0.4dB
GSM850 RX	869-894	0.4dB
EGSM900 TX	880-915	0.4dB
EGSM900 RX	935-960	0.4dB
GSM1800 TX	1710-1785	0.6dB
GSM1800 RX	1805-1880	0.6dB
GSM1900 TX	1850-1910	0.6dB
GSM1900 RX	1930-1990	0.6dB
WCDMA850 TX	824-849	0.4dB
WCDMA850 RX	869-894	0.4dB
WCDMA1900 TX	1850-1910	0.6dB
WCDMA1900 RX	1930-1990	0.6dB

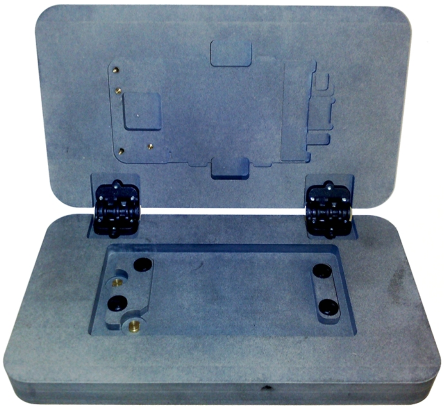
RJ-230	Soldering jig	

The jig is used for soldering and as a rework jig for the system module. It is made of lead-free rework compatible material.



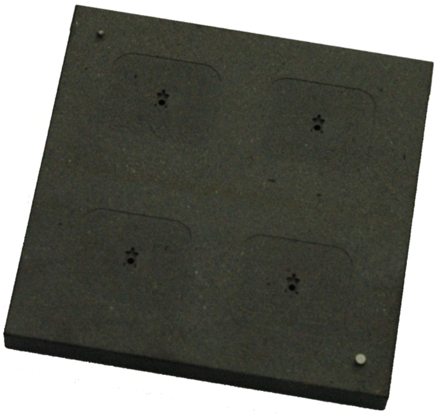
SA-154	RF coupler	

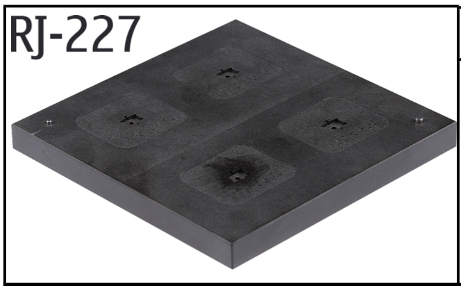
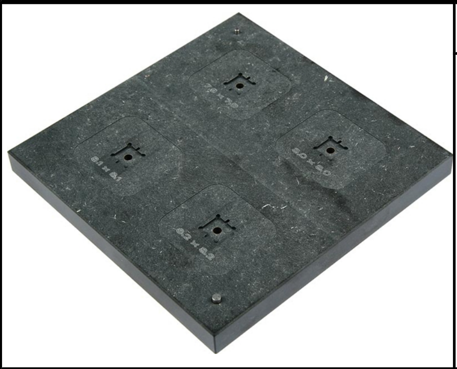
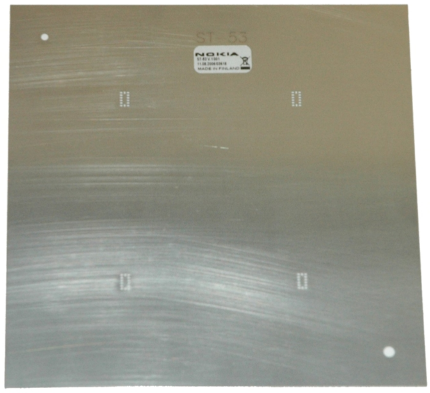
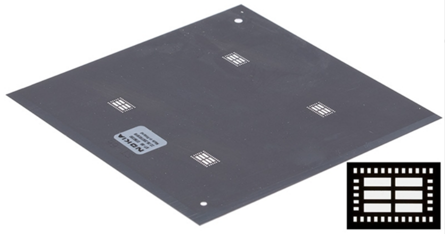
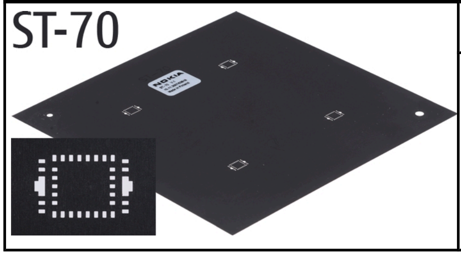
SA-154 is an RF coupler for WCDMA and GSM RF testing. It is used together with the product-specific flash adapter.

<table>
<tr><td rowspan="2"> </td><td>SS-100</td><td>Camera removal tool</td><td></td></tr>
<tr><td colspan="3">The camera removal tool SS-100 is used to remove/attach a camera module from/to the camera socket of the phone PWB.</td></tr>
<tr><td rowspan="2"></td><td>SS-157</td><td>Domesheet alignment jig</td><td></td></tr>
<tr><td colspan="3">SS-157 is used for domesheet alignment.</td></tr>
</table>

General tools

The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RM-333; RM-334. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

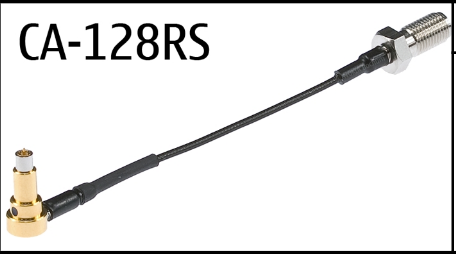
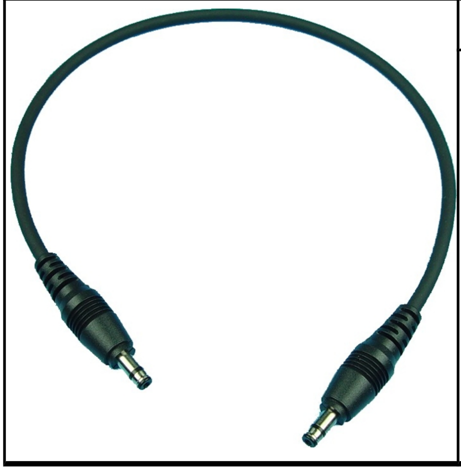
<table>
<tr><td rowspan="2"></td><td>RJ-166</td><td>Rework jig</td><td></td></tr>
<tr><td colspan="3">RJ-166 is a jig used for soldering and as a rework jig for the engine module. It is used together with the ST-53 stencil.</td></tr>
<tr><td rowspan="2"> </td><td>RJ-209</td><td>Rework jig</td><td></td></tr>
<tr><td colspan="3">RJ-209 is used as a rework jig for the WLAN 4.0 module
This stencil takes the WLAN 4.0 module for spreading soldering paste onto the component. This must be used together with the ST-64 rework stencil.</td></tr>
</table>

	RJ-227	Rework jig		RJ-227 is a rework jig used when servicing the BTHFM module (D6000). It is used together with the ST-70 rework stencil.
	RJ-93	Rework jig		RJ-93 is a rework jig used with ST-40.
	ST-53	Rework stencil		ST-53 is a rework stencil used with rework jig RJ-166.
	ST-64	Rework stencil		ST-64 is the stencil used during rework of the WLAN 4.0 module. It must be used together with the RJ-209 rework jig.
	ST-70	Rework stencil		ST-70 rework stencil is used with RJ-227 rework jig to service the BTHFM module (D6000).

Cables

The table below gives a short overview of service devices that can be used for testing, error analysis, and repair of product RM-333; RM-334. For the correct use of the service devices, and the best effort of workbench setup, please refer to various concepts.

<table>
<tr><td rowspan="2">
CA-101
100cm

</td><td>CA-101</td><td>Micro USB cable</td><td></td></tr>
<tr><td colspan="3">The CA-101 is a USB-to-microUSB data cable that allows connections between the PC and the phone.</td></tr>
<tr><td rowspan="2">
</td><td>CA-128RS</td><td>RF tuning cable</td><td></td></tr>
<tr><td colspan="3">Product-specific adapter cable for RF tuning.</td></tr>
<tr><td rowspan="2"> </td><td>CA-31D</td><td>USB cable</td><td></td></tr>
<tr><td colspan="3">The CA-31D USB cable is used to connect FPS-10 or FPS-11 to a PC. It is included in the FPS-10 and FPS-11 sales packages.</td></tr>
<tr><td rowspan="2"></td><td>CA-35S</td><td>Power cable</td><td></td></tr>
<tr><td colspan="3">CA-35S is a power cable for connecting, for example, the FPS-10 flash prommer to the Point-Of-Sales (POS) flash adapter.</td></tr>
</table>

<table>
<tr><td rowspan="2"> </td><td>PCS-1</td><td>Power cable</td><td></td></tr>
<tr><td colspan="3">The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled voltage.</td></tr>
<tr><td rowspan="2"> </td><td>XCS-1</td><td>Service cable</td><td></td></tr>
<tr><td colspan="3">The XCS-1 service cable is used to connect FLS-4S to the POS flash adapter for supplying a controlled operating voltage and data connection.</td></tr>
<tr><td rowspan="2"> </td><td>XCS-4</td><td>Modular cable</td><td></td></tr>
<tr><td colspan="3">XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes.</td></tr>
</table>

Service concepts

POS (Point of Sale) flash concept

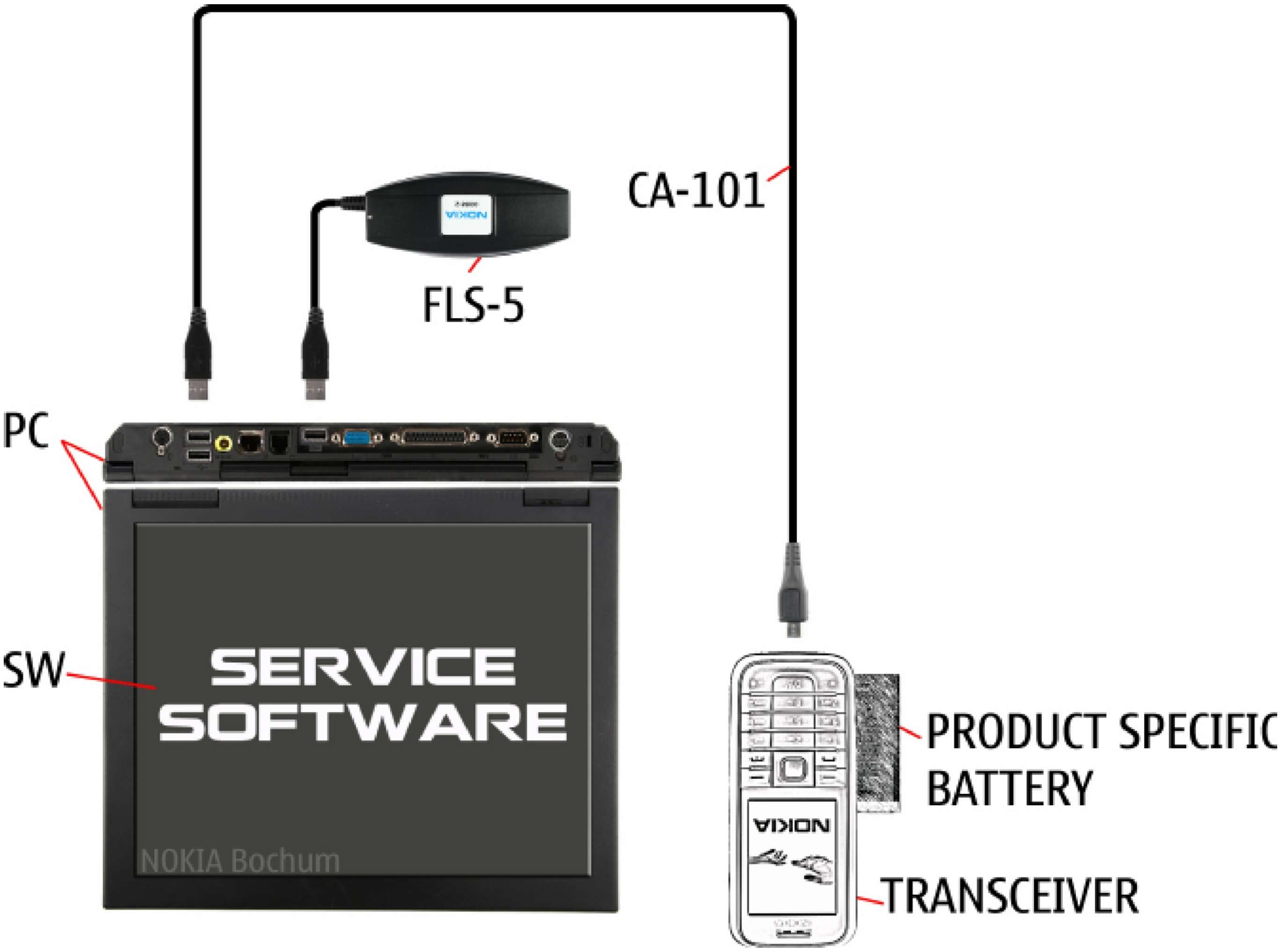

CA-101
FLS-5
PC
SW
SERVICE SOFTWARE
NOKIA Bochum
PRODUCT SPECIFIC BATTERY
TRANSCEIVER

Figure 2 POS flash concept

Type	Description
Product specific tools	
BL-5K	Battery
Other tools	
FLS-5	POS flash dongle
	PC with Phoenix service software
Cables	
CA-101	USB connectivity cable

Flash concept with FPS-10

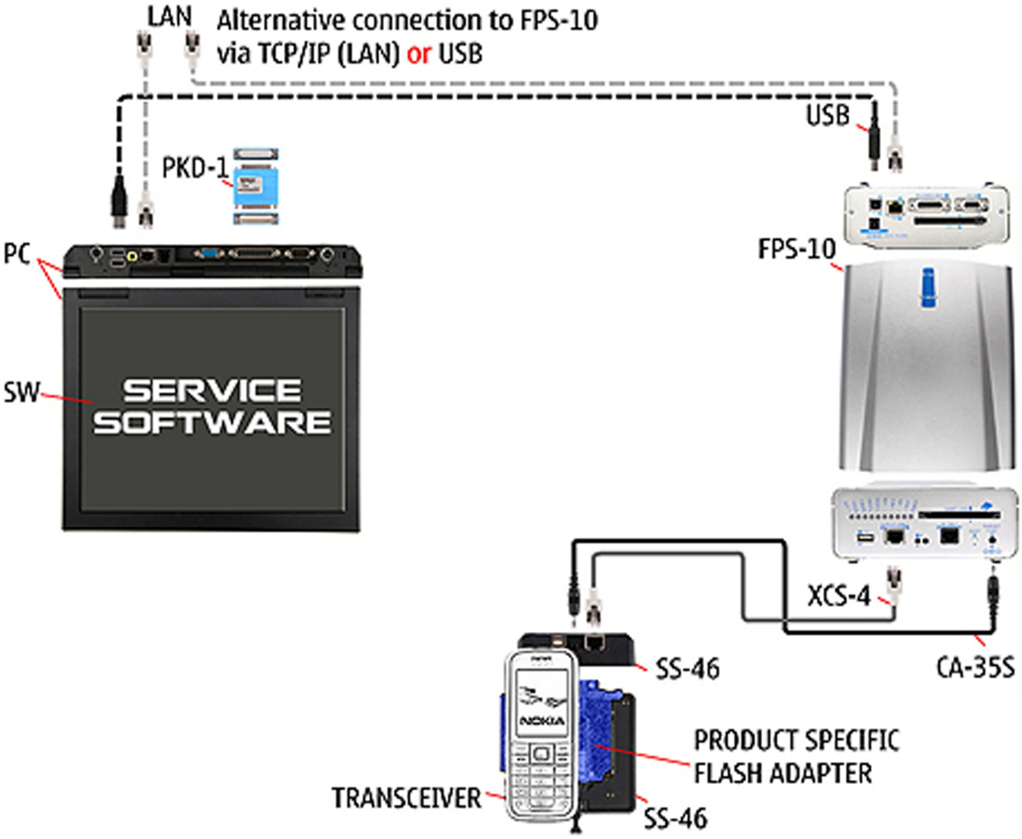

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
PKD-1
PC
FPS-10
SW
SERVICE
SOFTWARE
XCS-4
SS-46
CA-35S
PRODUCT SPECIFIC
FLASH ADAPTER
TRANSCEIVER
SS-46

Figure 3 Basic flash concept with FPS-10

Type	Description
Product specific devices	
FS-73	Flash adapter
Other devices	
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
CA-35S	Power cable
	USB cable

CU-4 flash concept with FPS-10

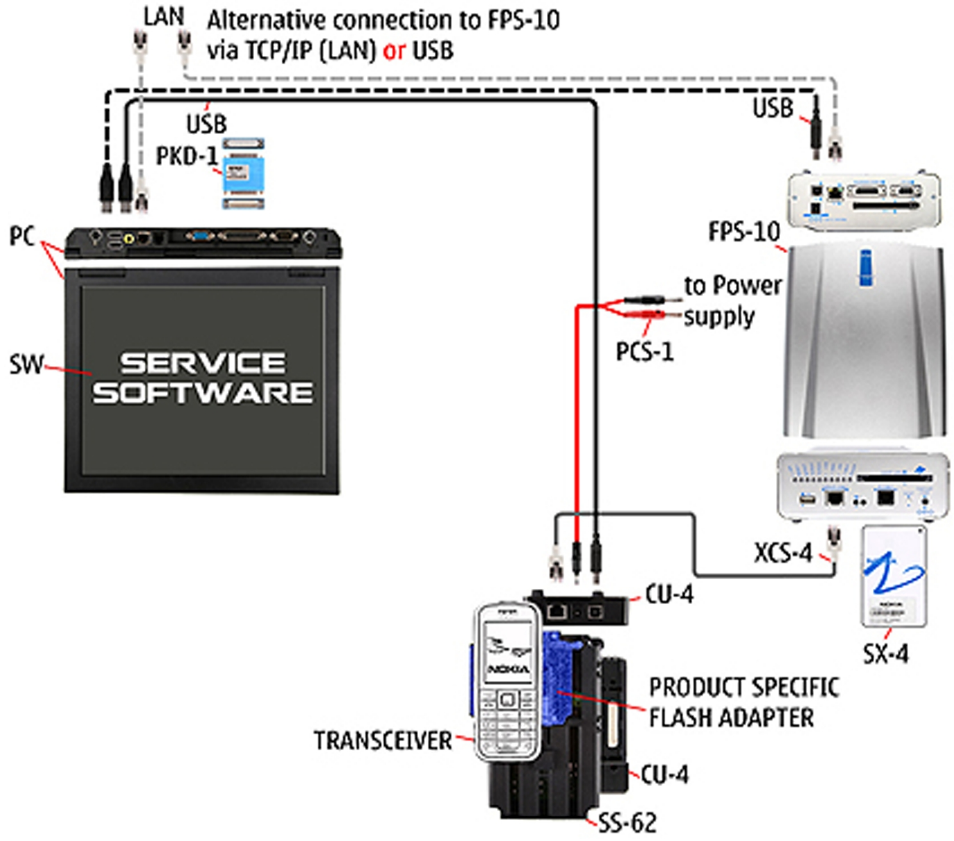

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
USB
USB
PKD-1
PC
SW
SERVICE
SOFTWARE
FPS-10
to Power
supply
PCS-1
XCS-4
CU-4
SX-4
PRODUCT SPECIFIC
FLASH ADAPTER
TRANSCEIVER
CU-4
SS-62

Figure 4 CU-4 flash concept with FPS-10

Type	Description
Product specific devices	
FS-73	Flash adapter
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
SX-4	Smart card
	PC with Phoenix service software
Cables	
PCS-1	Power cable
XCS-4	Modular cable
	Standard USB cable
	USB cable

Flash concept with FPS-10 and SB-6

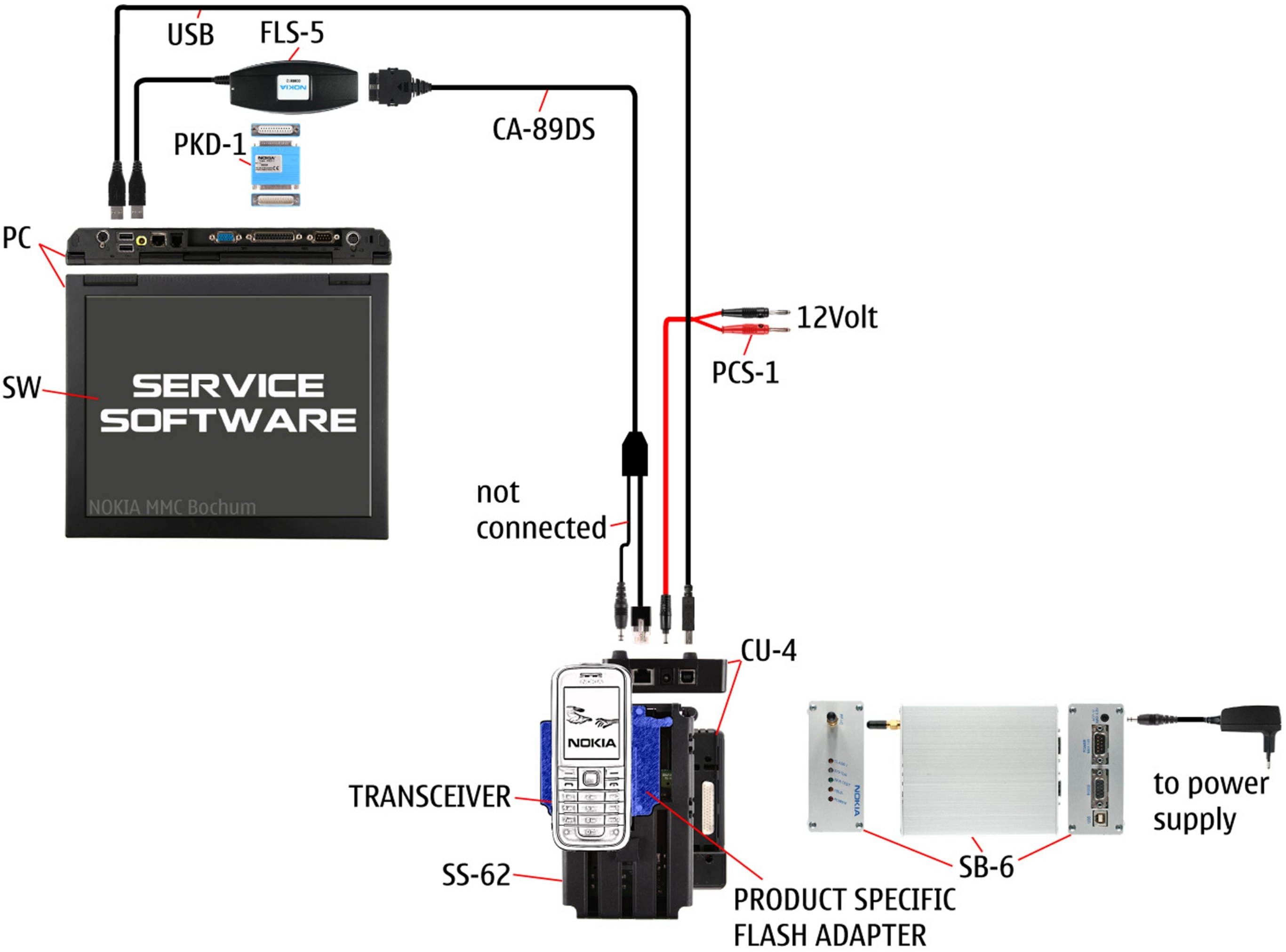

USB
FLS-5
CA-89DS
PKD-1
PC
SW
SERVICE SOFTWARE
NOKIA MMC Bochum
12Volt
PCS-1
not connected
CU-4
TRANSCEIVER
SS-62
PRODUCT SPECIFIC FLASH ADAPTER
SB-6
to power supply

Figure 5 Flash concept with FPS-10 and SB-6

Type	Description
Product specific tools	
FS-73	Flash adapter
Other tools	
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-46	Interface adapter
SB-6	Bluetooth test and interface box
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
CA-35S	Power cable

Type	Description
	USB cable

Flash concept with SS-46 and CA-89DS

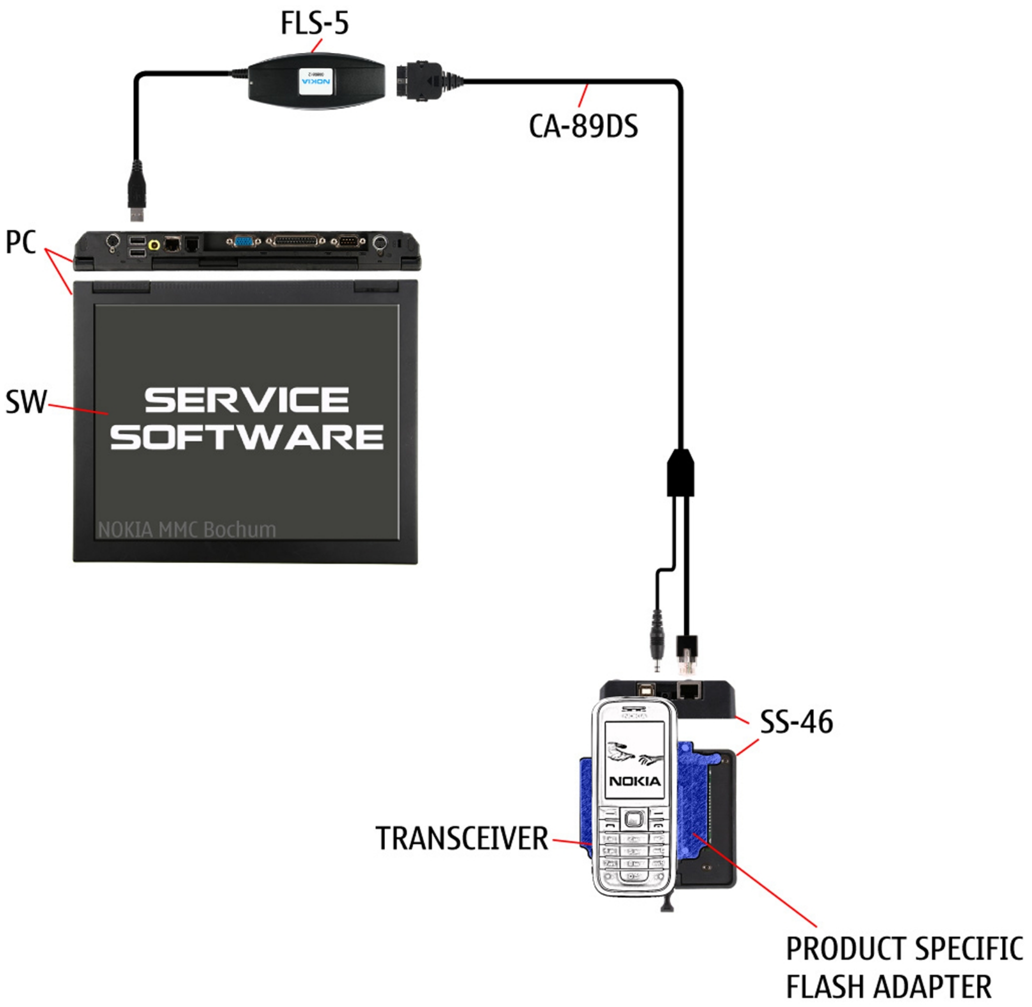

FLS-5
CA-89DS
PC
SW
SERVICE SOFTWARE
NOKIA MMC Bochum
SS-46
TRANSCEIVER
PRODUCT SPECIFIC FLASH ADAPTER

Figure 6 Flash concept with SS-46 and CA-89DS

Type	Description
Product specific tools	
FS-73	Flash adapter
Other tools	
FLS-5	Flash device
SS-46	Interface adapter
	PC with Phoenix service software
Cables	
CA-89DS	Cable

Flash concept with SS-62 and CA-89DS

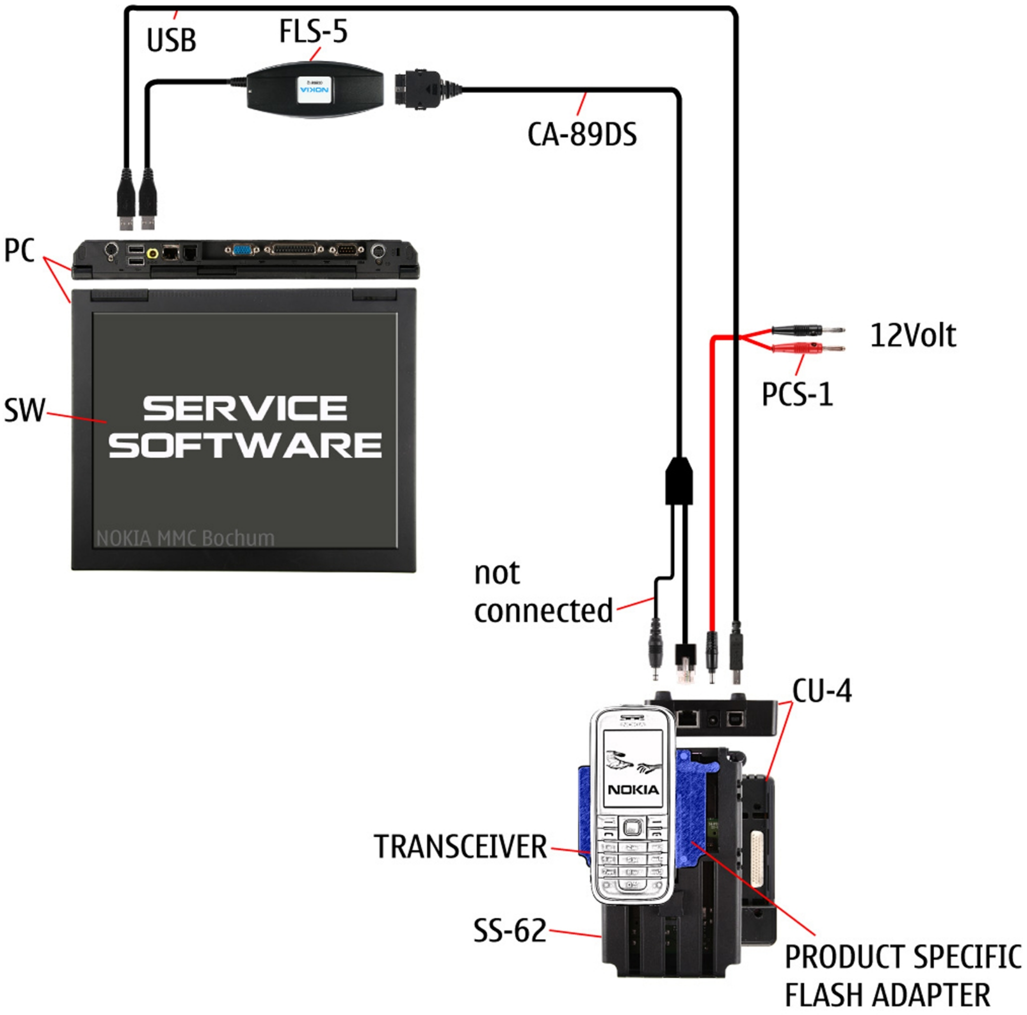

USB
FLS-5
CA-89DS
PC
SW
SERVICE SOFTWARE
NOKIA MMC Bochum
12Volt
PCS-1
not connected
CU-4
TRANSCEIVER
SS-62
PRODUCT SPECIFIC FLASH ADAPTER

Figure 7 Flash concept with SS-62 and CA-89DS

Type	Description
Product specific tools	
FS-73	Flash adapter
Other tools	
CU-4	Control unit
FLS-5	Flash device
SS-62	Flash adapter base
	PC with Phoenix service software
Cables	
CA-89DS	Cable
PCS-1	Power cable
	USB cable

Flash concept with FPS-10, SS-62 and SB-6

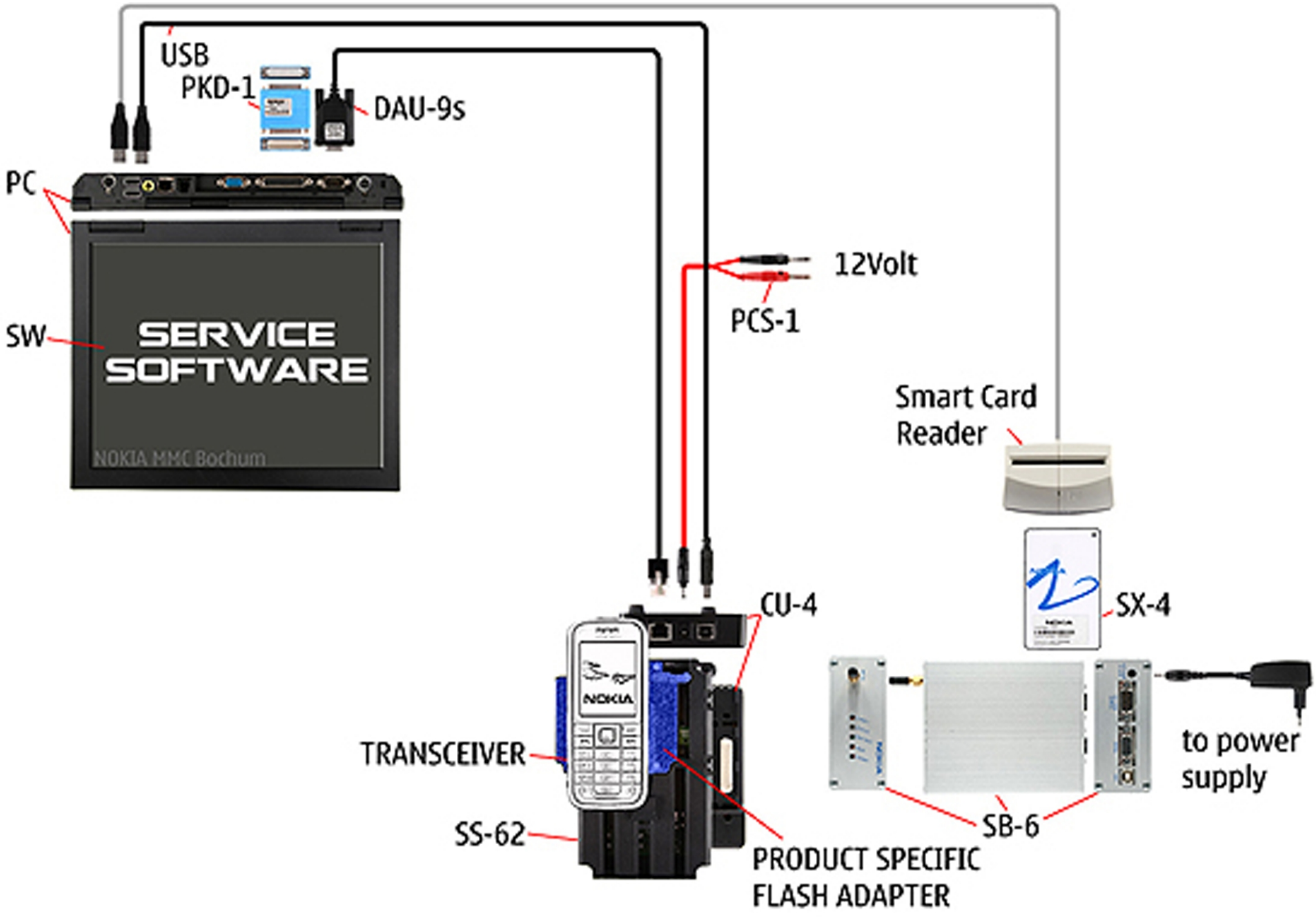

USB
PKD-1
DAU-9s
PC
SW
SERVICE SOFTWARE
NOKIA MMC Bochum
12Volt
PCS-1
Smart Card Reader
SX-4
CU-4
TRANSCEIVER
SS-62
PRODUCT SPECIFIC FLASH ADAPTER
SB-6
to power supply

Figure 8 Flash concept with FPS-10, SS-62 and SB-6

Type	Description
Product specific tools	
FS-73	Flash adapter
Other tools	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
SB-6	Bluetooth test and interface box
SX-4	Smart card
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
PCS-1	Power cable

Type	Description
	USB cable

Flash concept with FPS-10, SS-62 and SB-7

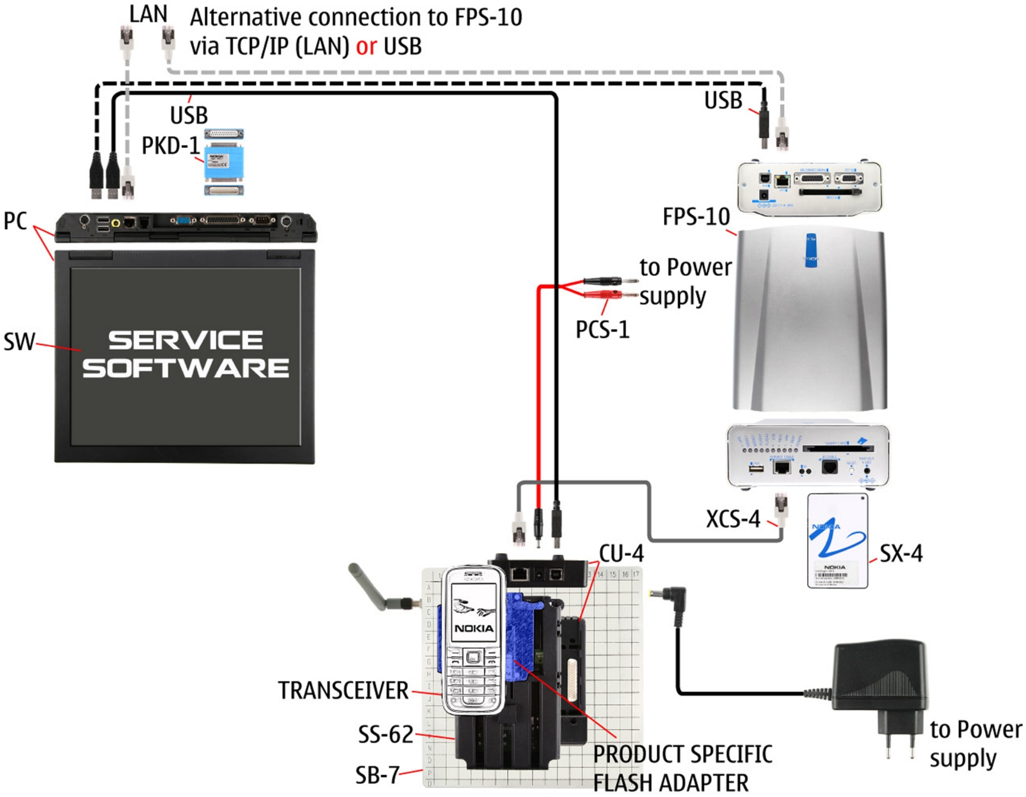

LAN
Alternative connection to FPS-10 via TCP/IP (LAN) or USB
USB
PKD-1
USB
PC
SW
SERVICE SOFTWARE
FPS-10
to Power supply
PCS-1
XCS-4
SX-4
CU-4
TRANSCEIVER
SS-62
SB-7
PRODUCT SPECIFIC FLASH ADAPTER
to Power supply

Figure 9 Flash concept with FPS-10, SB-7 and JBT-9

Type	Description
Product specific tools	
FS-73	Flash adapter
Other tools	
CU-4	Control unit
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SB-7	WLAN test box
SS-62	Flash adapter base
SX-4	Smart card
	PC with Phoenix service software
Cables	
XCS-4	Modular cable
PCS-1	Power cable

Type	Description
	USB cable

Module jig service concept

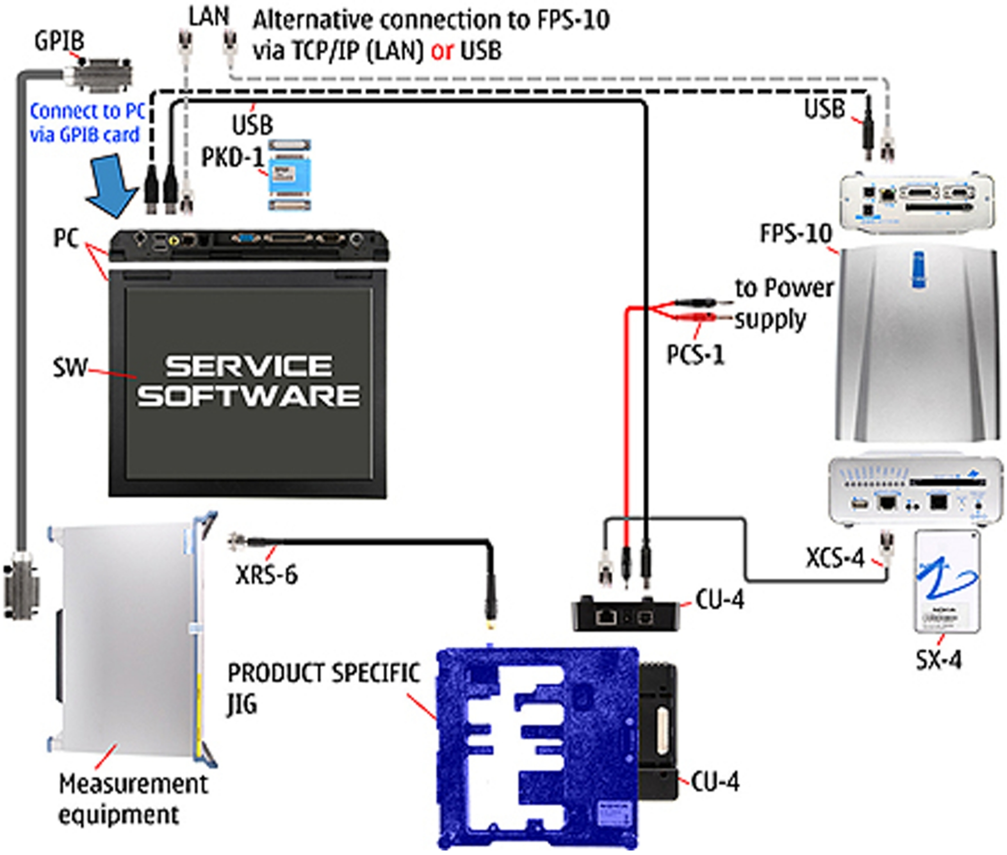

GPIB
LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
Connect to PC
via GPIB card
USB
PKD-1
USB
PC
FPS-10
to Power
supply
PCS-1
SW
SERVICE
SOFTWARE
XRS-6
XCS-4
CU-4
SX-4
PRODUCT SPECIFIC
JIG
CU-4
Measurement
equipment

Figure 10 Module jig service concept

Type	Description
Phone specific devices	
MJ-161	Module jig
Other devices	
CU-4	Control unit
FPS-10	Flash prommer box
PK-1	SW security device
SX-4	Smart card
	PC with VPOS and Phoenix service software
	Measurement equipment
Cables	
PCS-1	DC power cable
XCS-4	Modular cable

Type	Description
XRF-1	RF cable
CA-128RS	RF tuning cable
	USB cable
	GPIB control cable

Module jig service concept with SB-6

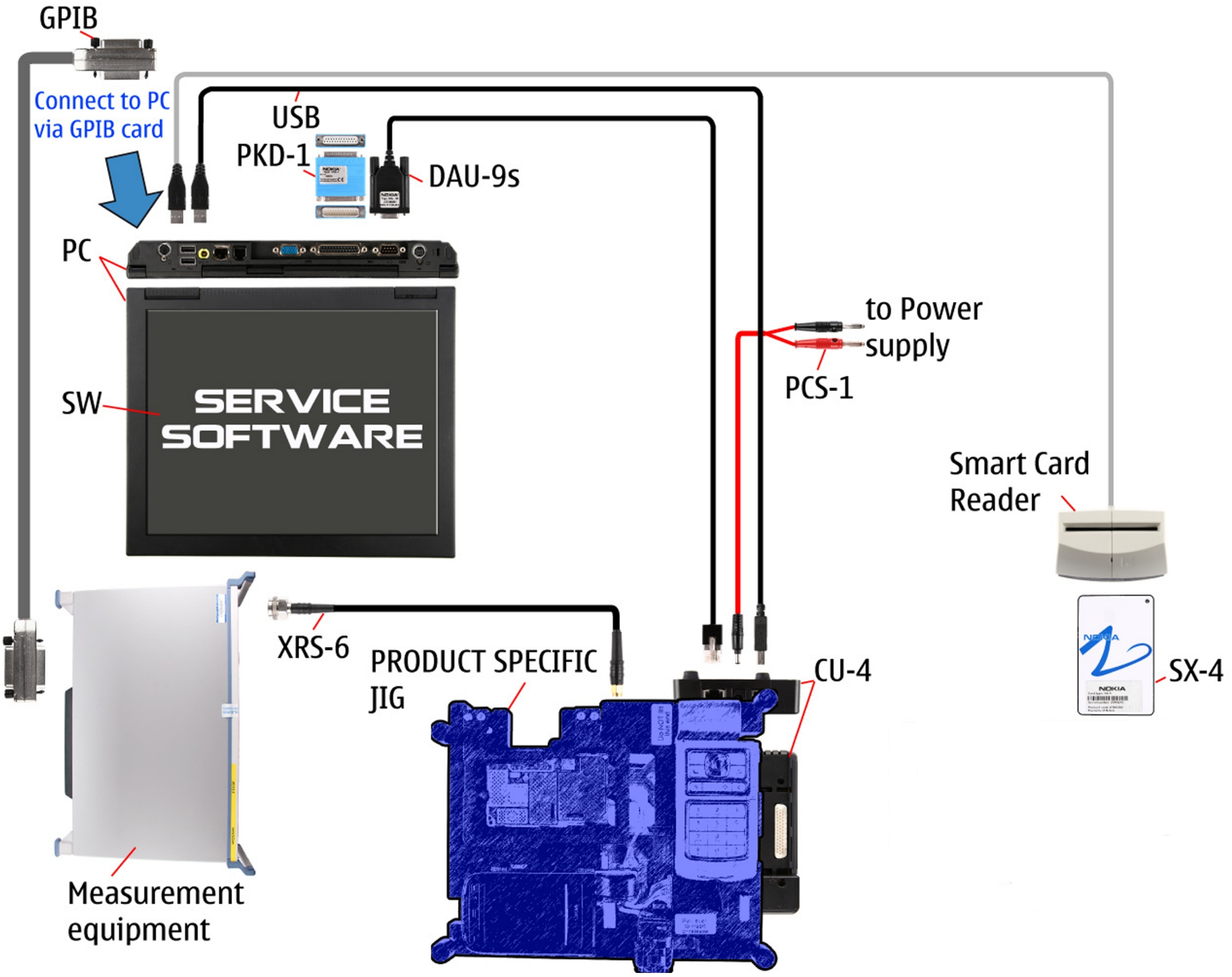

GPIB
Connect to PC via GPIB card
USB
PKD-1
DAU-9s
PC
SW
SERVICE SOFTWARE
to Power supply
PCS-1
Smart Card Reader
XRS-6
PRODUCT SPECIFIC JIG
CU-4
SX-4
Measurement equipment

Figure 11 Module jig service concept with SB-6

Type	Description
Product specific tools	
MJ-161	Module jig
Other tools	
CU-4	Control unit
FPS-10	Flash prommer box

Type	Description
SB-6	Bluetooth test and interface box
PKD-1	SW security device
SX-4	Smart card
	Measurement equipment
	PC with Phoenix service software
Cables	
PCS-1	DC power cable
XCS-4	Modular cable
XRS-6	RF cable
CA-128RS	RF tuning cable
	GPIB control cable
	USB cable

RF testing concept with RF coupler

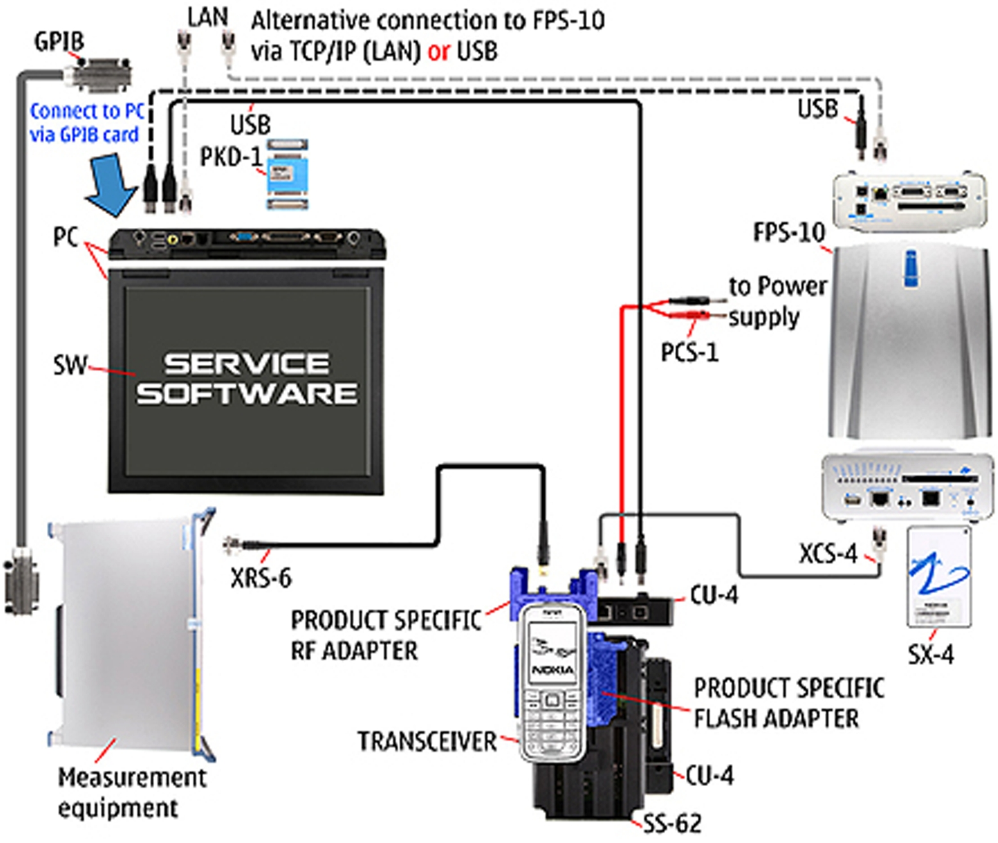

LAN
Alternative connection to FPS-10
via TCP/IP (LAN) or USB
GPIB
Connect to PC via GPIB card
USB
PKD-1
USB
PC
FPS-10
to Power supply
PCS-1
SW
SERVICE SOFTWARE
XCS-4
XRS-6
CU-4
PRODUCT SPECIFIC RF ADAPTER
SX-4
PRODUCT SPECIFIC FLASH ADAPTER
TRANSCEIVER
CU-4
Measurement equipment
SS-62

Figure 12 RF testing concept with RF coupler

Type	Description
Product specific devices	
FS-73	Flash adapter

Type	Description
SA-154	RF coupler
Other devices	
CU-4	Control unit
SX-4	Smart card
FPS-10	Flash prommer box
PKD-1/PK-1	SW security device
SS-62	Flash adapter base
	Measurement equipment
	PC with Phoenix service software
Cables	
PCS-1	Power cable
XCS-4	Modular cable
XRS-6	RF cable
	GPIB control cable
	USB cable

Service concept for RF testing and RF/BB tuning

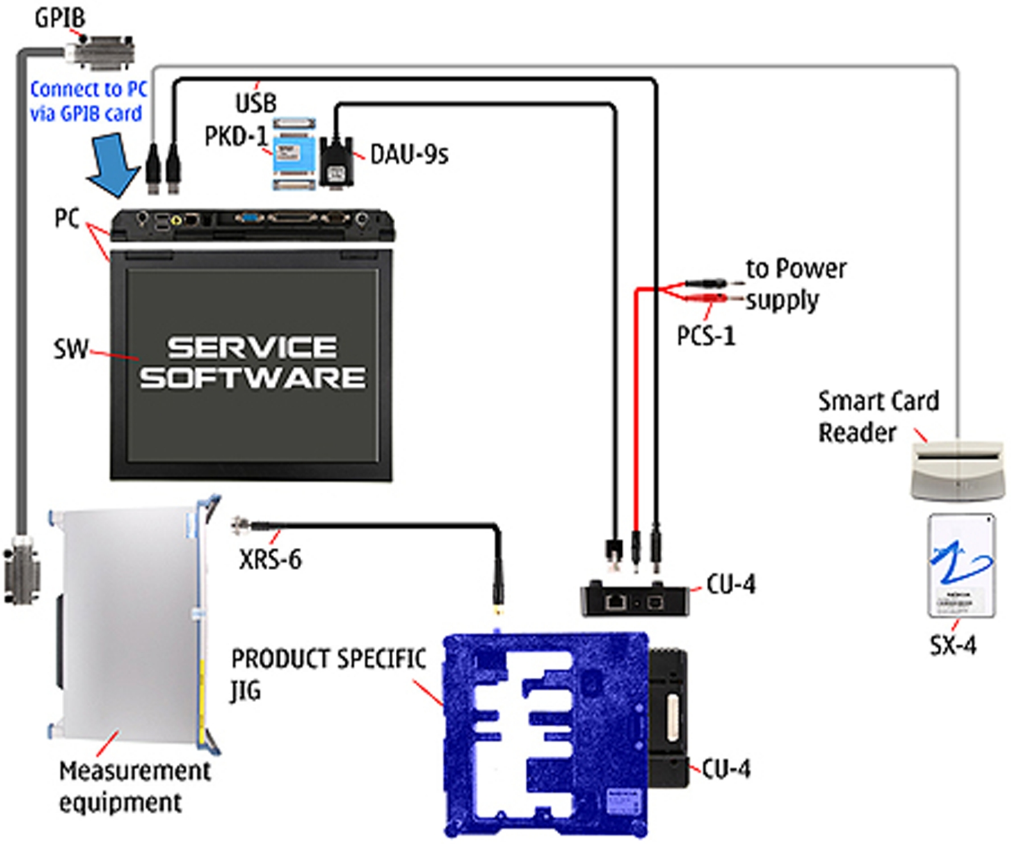

GPIB
Connect to PC via GPIB card
USB
PKD-1
DAU-9s
PC
SW
SERVICE SOFTWARE
to Power supply
PCS-1
Smart Card Reader
XRS-6
CU-4
SX-4
PRODUCT SPECIFIC JIG
CU-4
Measurement equipment

Figure 13 Service concept for RF testing and RF/BB tuning

Type	Description
Product specific devices	
MJ-161	Module jig
Other devices	
CU-4	Control unit
PK-1/PKD-1	SW security device
SX-4	Smart card
	Measurement equipment
	Smart card reader
	PC with Phoenix service software
Cables	
DAU-9S	MBUS cable
PCS-1	DC power cable
XRS-6	RF cable
CA-128RS	RF tuning cable
	GPIB control cable
	USB cable

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3 — BB Troubleshooting

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Table of Contents

Baseband main troubleshooting....3–5
General power checking....3–7
Backup battery troubleshooting....3–8
Dead or jammed device troubleshooting....3–10
Keyboard troubleshooting....3–11
Hall sensor troubleshooting....3–13
TV- out troubleshooting....3–14
General power checking troubleshooting....3–15
USB troubleshooting....3–16
SIM card troubleshooting....3–17
MicroSD card troubleshooting....3–18
Combo memory troubleshooting....3–20
Flash programming troubleshooting....3–21
USB charging troubleshooting....3–24
Clocking troubleshooting....3–25
Power key troubleshooting....3–26
Naviscroll troubleshooting....3–27
User interface troubleshooting....3–28
Display Troubleshooting....3–29
    Display Troubleshooting....3–29
    Illumination troubleshooting....3–30
    LED driver troubleshooting....3–33
    I/O expander troubleshooting....3–35
Audio Troubleshooting....3–35
    Audio troubleshooting test instructions....3–35
    External earpiece troubleshooting....3–39
    DAC33 troubleshooting....3–40
    External microphone troubleshooting....3–41
    Internal earpiece troubleshooting....3–42
    Internal handsfree speaker troubleshooting....3–43
    Internal microphone troubleshooting....3–44
    Vibra troubleshooting....3–45
ALS Technical Description and Troubleshooting....3–46
    Ambient Light Sensor....3–46
    ALS troubleshooting....3–46
    Re-tuning ALS....3–47
Bluetooth and FM Radio Troubleshooting....3–48
    Introduction to Bluetooth/FM radio troubleshooting....3–48
    Bluetooth BER test....3–51
    Bluetooth and FM radio self tests in Phoenix....3–52
    Bluetooth troubleshooting....3–53
    FM radio troubleshooting....3–54
    FM radio testing....3–55
GPS Troubleshooting....3–55
    GPS layout and basic test points....3–55
    GPS Settings for Phoenix....3–56
        GPS control....3–56
        Quick Test window....3–57
    GPS failure troubleshooting....3–59
WLAN Troubleshooting....3–59

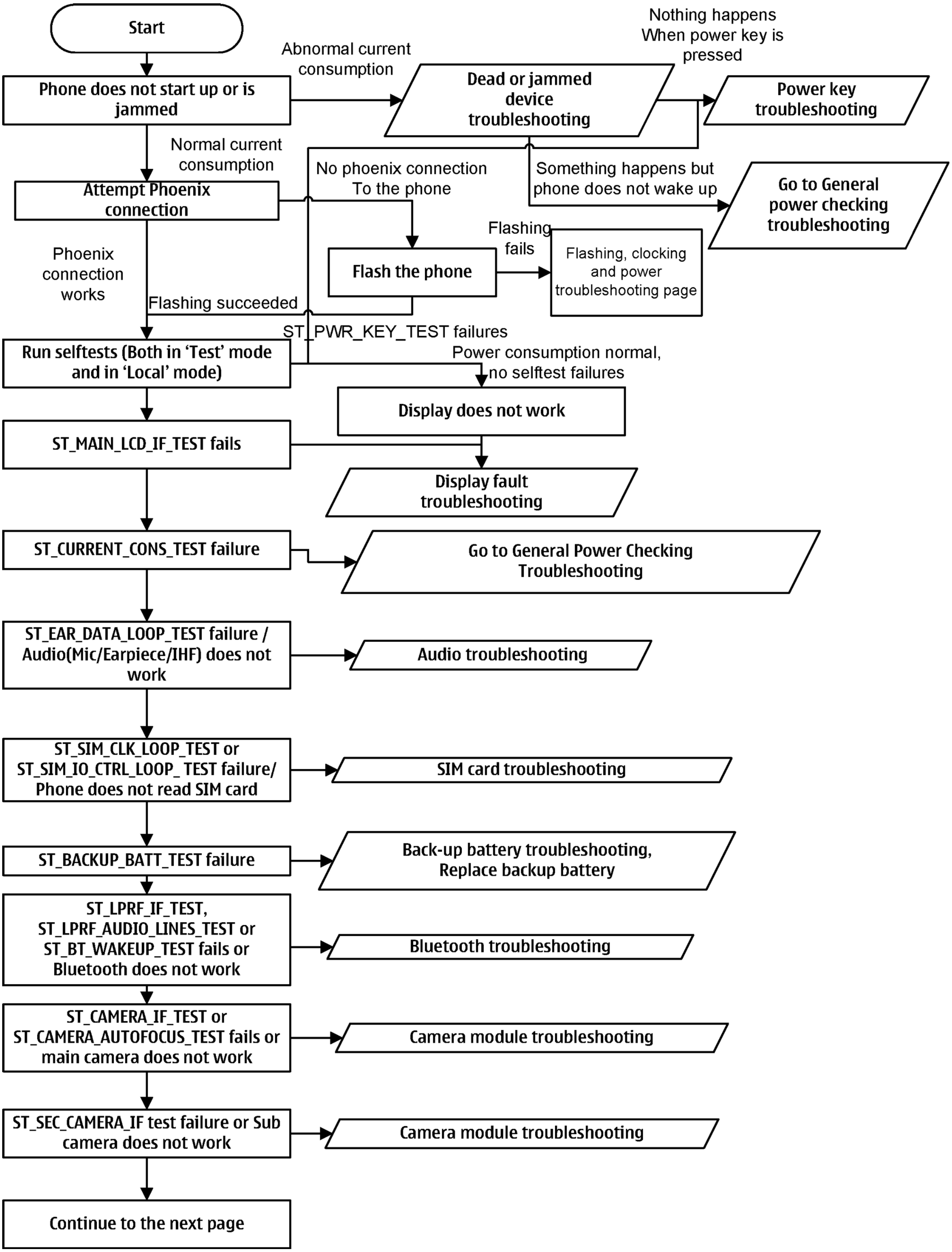
WLAN functional description 3–59
WLAN settings for Phoenix 3–60
WLAN functional tests 3–62
WLAN auto tuning 3–64

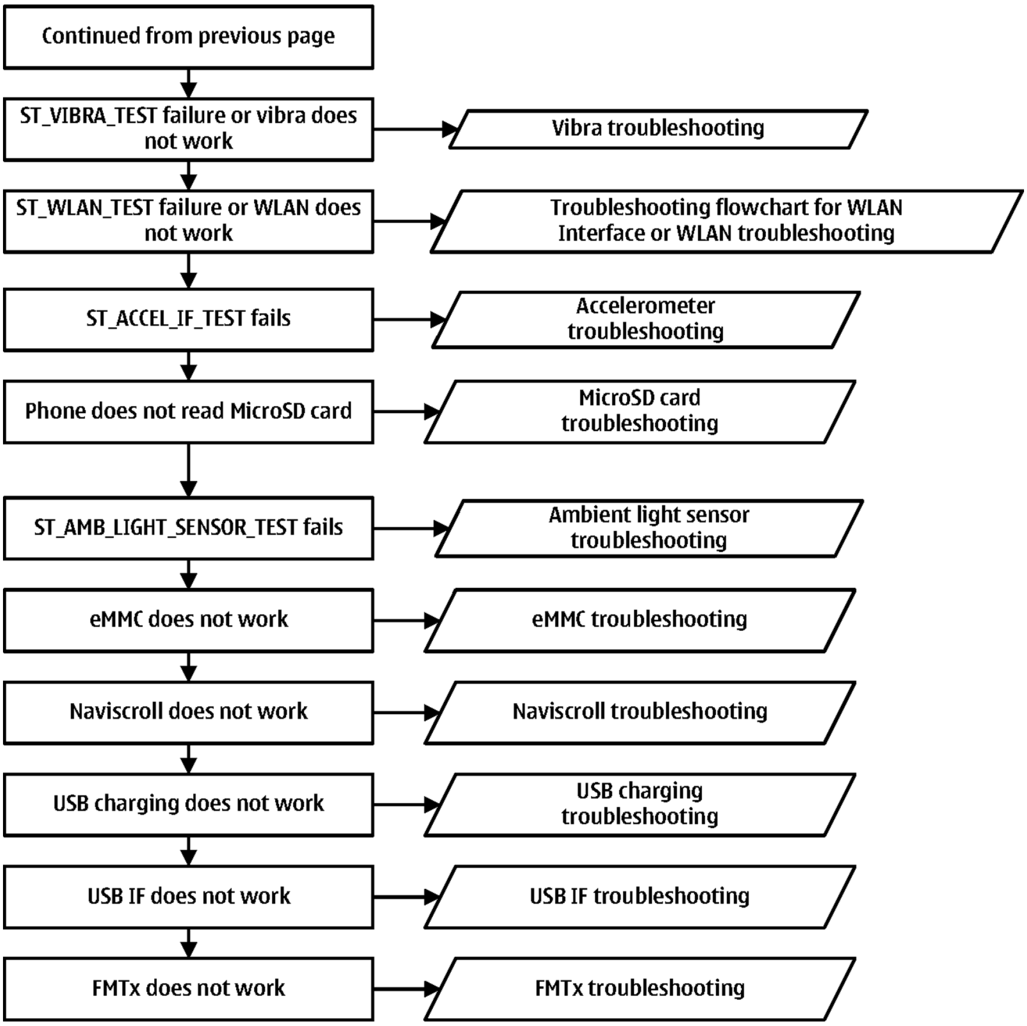
List of Figures

Figure 14 Single-ended output waveform of the Ext_in_HP_out measurement when earpiece is connected 3–37
Figure 15 Single-ended output waveform of the Ext_in_IHF_out out loop measurement when speaker is connected (measured at speaker pads), no filter is used 3–37
Figure 16 Single-ended output waveform of the Ext_in_Ext_out loop 3–38
Figure 17 Single-ended output waveform of the Digital_stereo_microphone_in_Ext_out loop 3–38
Figure 18 Ambient Light Sensor 3–46
Figure 19 Bluetooth/WLAN antenna 3–49
Figure 20 BT/FM component layout 3–51
Figure 21 Bluetooth and FM radio self tests in Phoenix 3–52
Figure 22 GPS layout and basic test points 3–56
Figure 23 GPS Control dialogue box 3–57
Figure 24 GPS Quick Test window 3–58
Figure 25 WLAN circuitry 3–60
Figure 26 WLAN auto tune settings 3–65
Figure 27 WLAN auto tune results 3–66

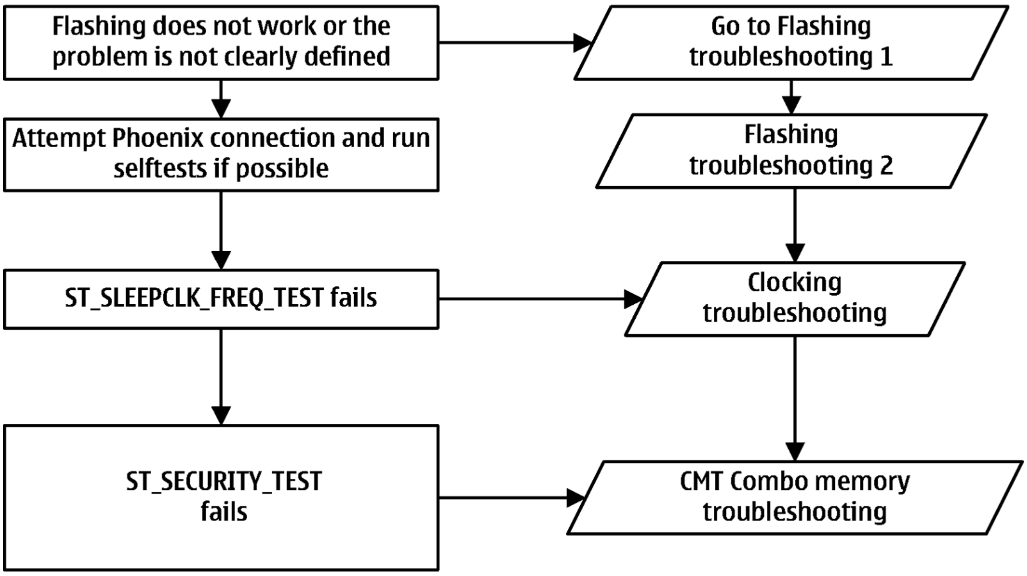
Baseband main troubleshooting

Troubleshooting flow


Start
Phone does not start up or is jammed
Abnormal current consumption
Dead or jammed device troubleshooting
Nothing happens When power key is pressed
Power key troubleshooting
Normal current consumption
Attempt Phoenix connection
No phoenix connection To the phone
Something happens but phone does not wake up
Go to General power checking troubleshooting
Phoenix connection works
Flash the phone
Flashing fails
Flashing, clocking and power troubleshooting page
Flashing succeeded
ST_PWR_KEY_TEST failures
Run selftests (Both in 'Test' mode and in 'Local' mode)
Power consumption normal, no selftest failures
Display does not work
ST_MAIN_LCD_IF_TEST fails
Display fault troubleshooting
ST_CURRENT_CONS_TEST failure
Go to General Power Checking Troubleshooting
ST_EAR_DATA_LOOP_TEST failure / Audio(Mic/Earpiece/IHF) does not work
Audio troubleshooting
ST_SIM_CLK_LOOP_TEST or ST_SIM_IO_CTRL_LOOP_ TEST failure/ Phone does not read SIM card
SIM card troubleshooting
ST_BACKUP_BATT_TEST failure
Back-up battery troubleshooting, Replace backup battery
ST_LPRF_IF_TEST, ST_LPRF_AUDIO_LINES_TEST or ST_BT_WAKEUP_TEST fails or Bluetooth does not work
Bluetooth troubleshooting
ST_CAMERA_IF_TEST or ST_CAMERA_AUTOFOCUS_TEST fails or main camera does not work
Camera module troubleshooting
ST_SEC_CAMERA_IF test failure or Sub camera does not work
Camera module troubleshooting
Continue to the next page


Continued from previous page
ST_VIBRA_TEST failure or vibra does not work
Vibra troubleshooting
ST_WLAN_TEST failure or WLAN does not work
Troubleshooting flowchart for WLAN Interface or WLAN troubleshooting
ST_ACCEL_IF_TEST fails
Accelerometer troubleshooting
Phone does not read MicroSD card
MicroSD card troubleshooting
ST_AMB_LIGHT_SENSOR_TEST fails
Ambient light sensor troubleshooting
eMMC does not work
eMMC troubleshooting
Naviscroll does not work
Naviscroll troubleshooting
USB charging does not work
USB charging troubleshooting
USB IF does not work
USB IF troubleshooting
FMTx does not work
FMTx troubleshooting

Flashing, clocking and power troubleshooting


Flashing does not work or the problem is not clearly defined
Go to Flashing troubleshooting 1
Attempt Phoenix connection and run selftests if possible
Flashing troubleshooting 2
ST_SLEEPCLK_FREQ_TEST fails
Clocking troubleshooting
ST_SECURITY_TEST fails
CMT Combo memory troubleshooting

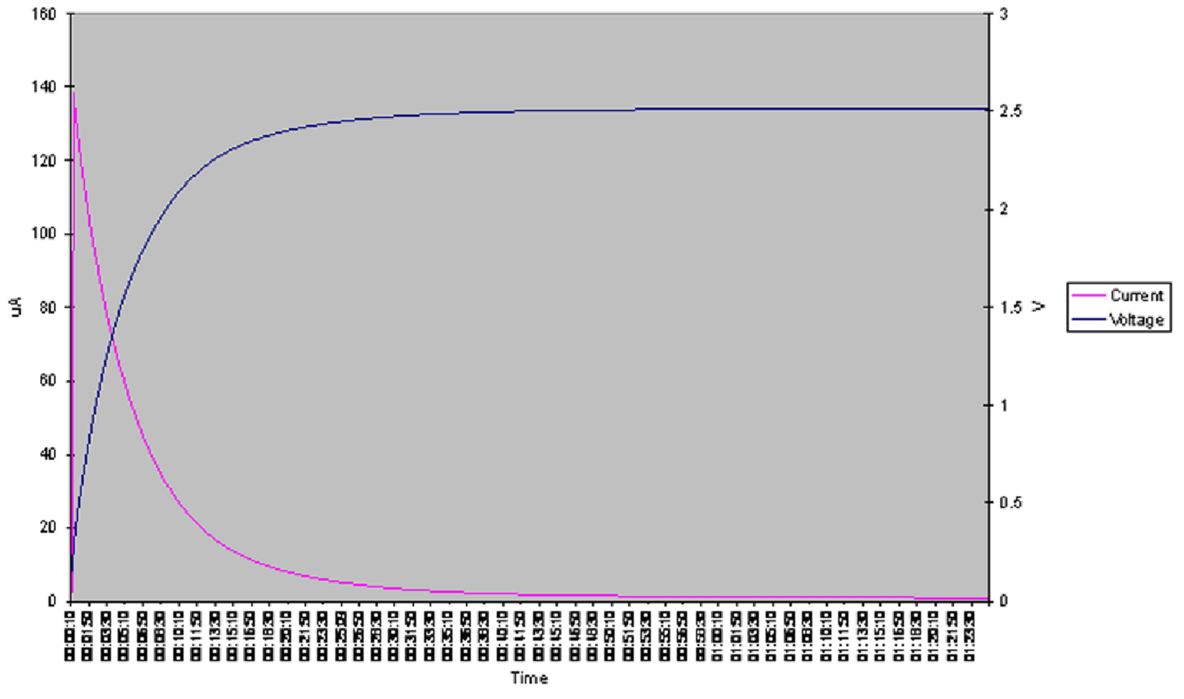
General power checking

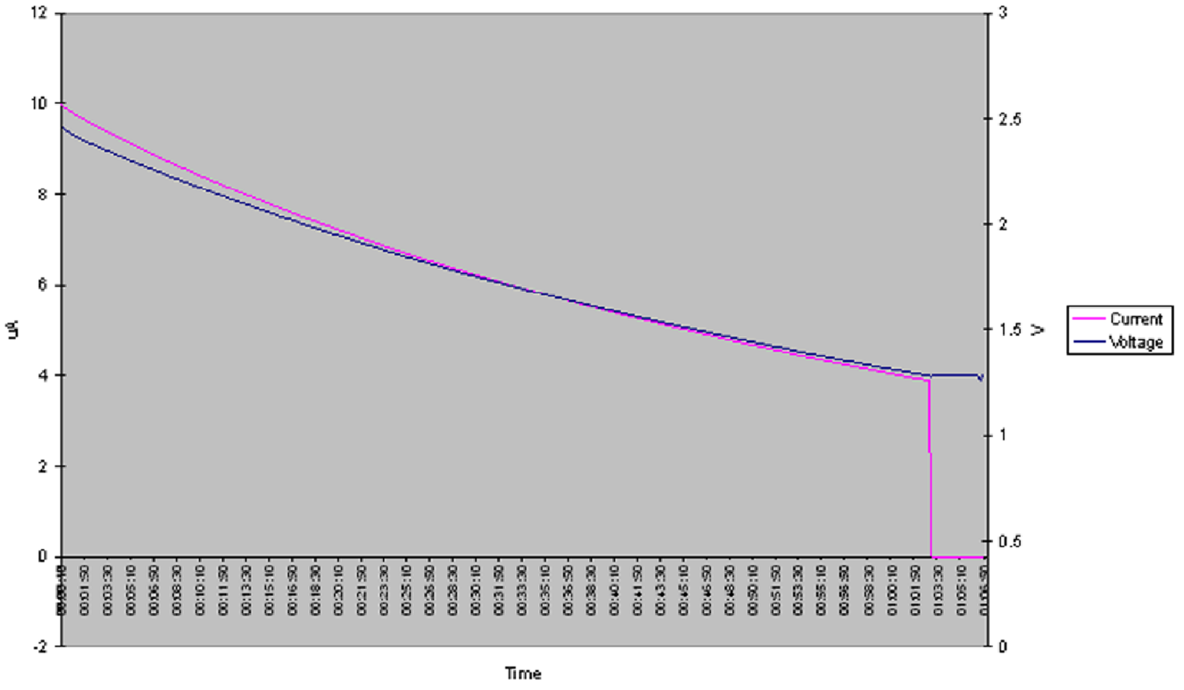
Check the following voltages:

Signal name	Regulator	Sleep	Idle	Nominal voltage	Main user	Notes
VIO_V	AVILMA	ON	ON	1.82	Not used	
VBACK	AVILMA	ON	ON	2.5	RTC circuitry	
VSIM1	AVILMA	ON	ON	1.8/3.0	Sim card	
VSIM2	AVILMA	ON	ON	3.0	Digital microphone	
VAUX	AVILMA	OFF	OFF	2.78	Accelerometer, Hall switches, 2nd camera	
VANA	AVILMA	ON	ON	2.5	Vilma internal	
VR1	AVILMA	OFF	ON	2.5	VCTXO	
VRFC	AVILMA	ON	OFF	1.8	RAPIDO converter	
VRCP1	AVILMA	OFF	OFF	4.75	RFmodule	RF active
VIO	LM3677	ON	ON	1.8	Rapido , Betty I/O	
VDRAM	LM3677	ON	ON	1.8	M3 Memory	
VCORE	TPS62350	ON	ON	1.2	Rapido core	
VDAC	LP3985			3.0	DAC33	On when used
VCAM_1V8	LM3677	OFF	OFF	1.8	Julie, LP5952	
VCAM_1V3		OFF	OFF	1.3	Julie,core	
VCAM_2V8		OFF	OFF	2.8	Main camera	
VSD	LP3930	OFF	OFF	2.9	SD card	On when used
V_ELVDD	TPS65136	OFF	OFF	4.6	Falcon OLED Display	
V_ELVSS	TPS65136	OFF	OFF	-4.9	Falcon OLED Display	
VCORE_WD	LP5952	OFF	OFF	1.5	White Dwarf Core	
VBAT				3.6		
VCORE	BETTY	OFF	OFF	1.2	Not used	
VDRAM_V	AVILMA		ON	1.82	Not used	
VLED	BETTY			6-18	Not used	

Backup battery troubleshooting

Verify that the backup battery G2200 is empty (U<1V). Switch the phone on. Measure voltage of the battery when the main battery is connected to the phone and the phone is switched on. Wait a few minutes and monitor that the backup battery voltage rises. Switch off the phone, disconnect the main battery and monitor that the voltage of the backup battery decreases. Normal behaviour of the voltage is described in the figures below:

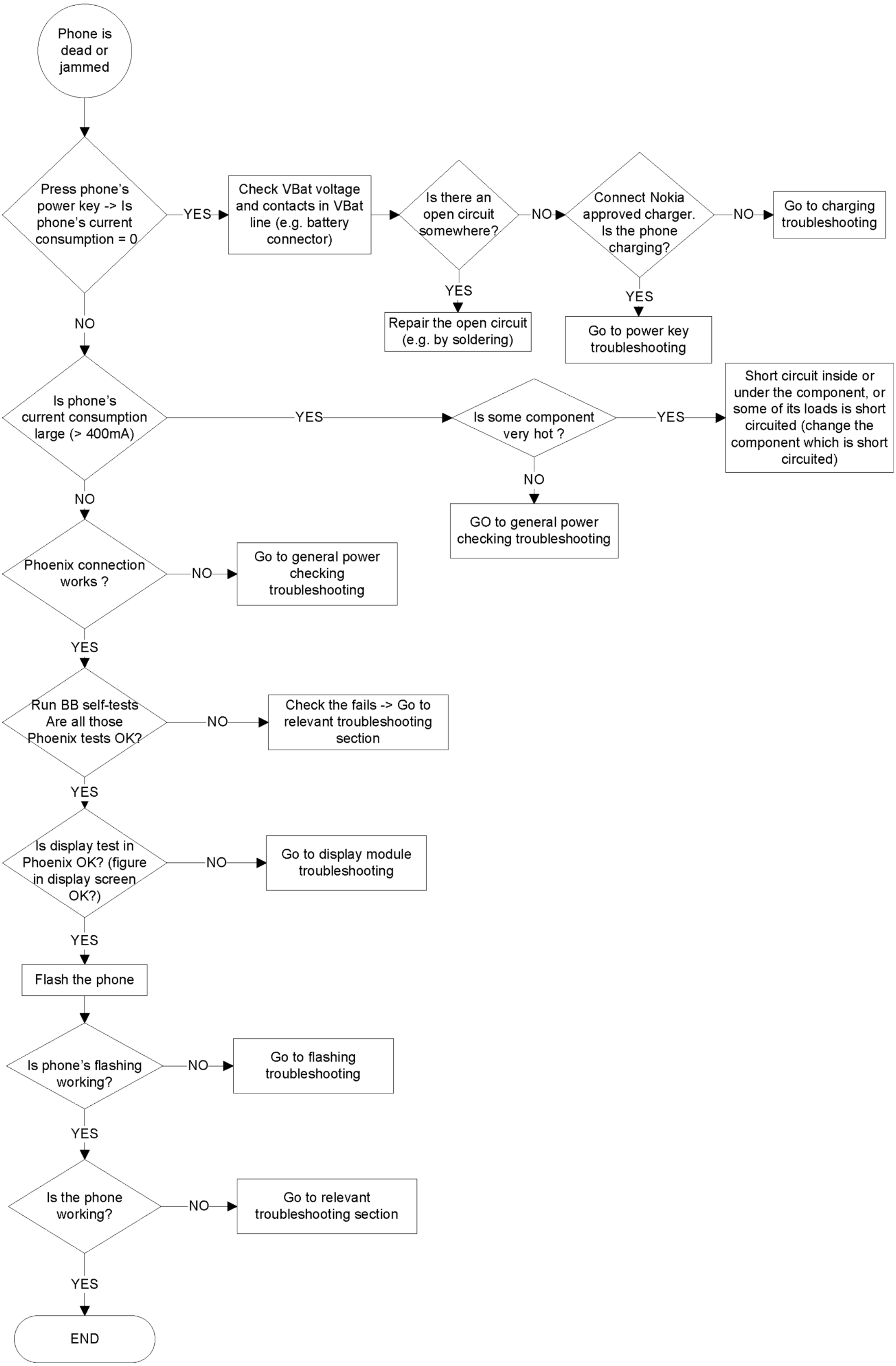




If the voltage rises and falls quickly, check the back-up battery G2200 contacts for loose soldering or short-circuit, and repair or change G2200 if necessary. If the voltage stays ~0V, check resistance VBACK against GND. If there is no shortcircuit, AVILMA N2200 is faulty. Replace N2200.

Dead or jammed device troubleshooting

Troubleshooting flow


Phone is dead or jammed
Press phone's power key -> Is phone's current consumption = 0
YES
Check VBat voltage and contacts in VBat line (e.g. battery connector)
Is there an open circuit somewhere?
NO
Connect Nokia approved charger. Is the phone charging?
NO
Go to charging troubleshooting
YES
Repair the open circuit (e.g. by soldering)
YES
Go to power key troubleshooting
NO
Is phone's current consumption large (> 400mA)
YES
Is some component very hot ?
YES
Short circuit inside or under the component, or some of its loads is short circuited (change the component which is short circuited)
NO
GO to general power checking troubleshooting
NO
Phoenix connection works ?
NO
Go to general power checking troubleshooting
YES
Run BB self-tests Are all those Phoenix tests OK?
NO
Check the fails -> Go to relevant troubleshooting section
YES
Is display test in Phoenix OK? (figure in display screen OK?)
NO
Go to display module troubleshooting
YES
Flash the phone
Is phone's flashing working?
NO
Go to flashing troubleshooting
YES
Is the phone working?
NO
Go to relevant troubleshooting section
YES
END

■ Keyboard troubleshooting

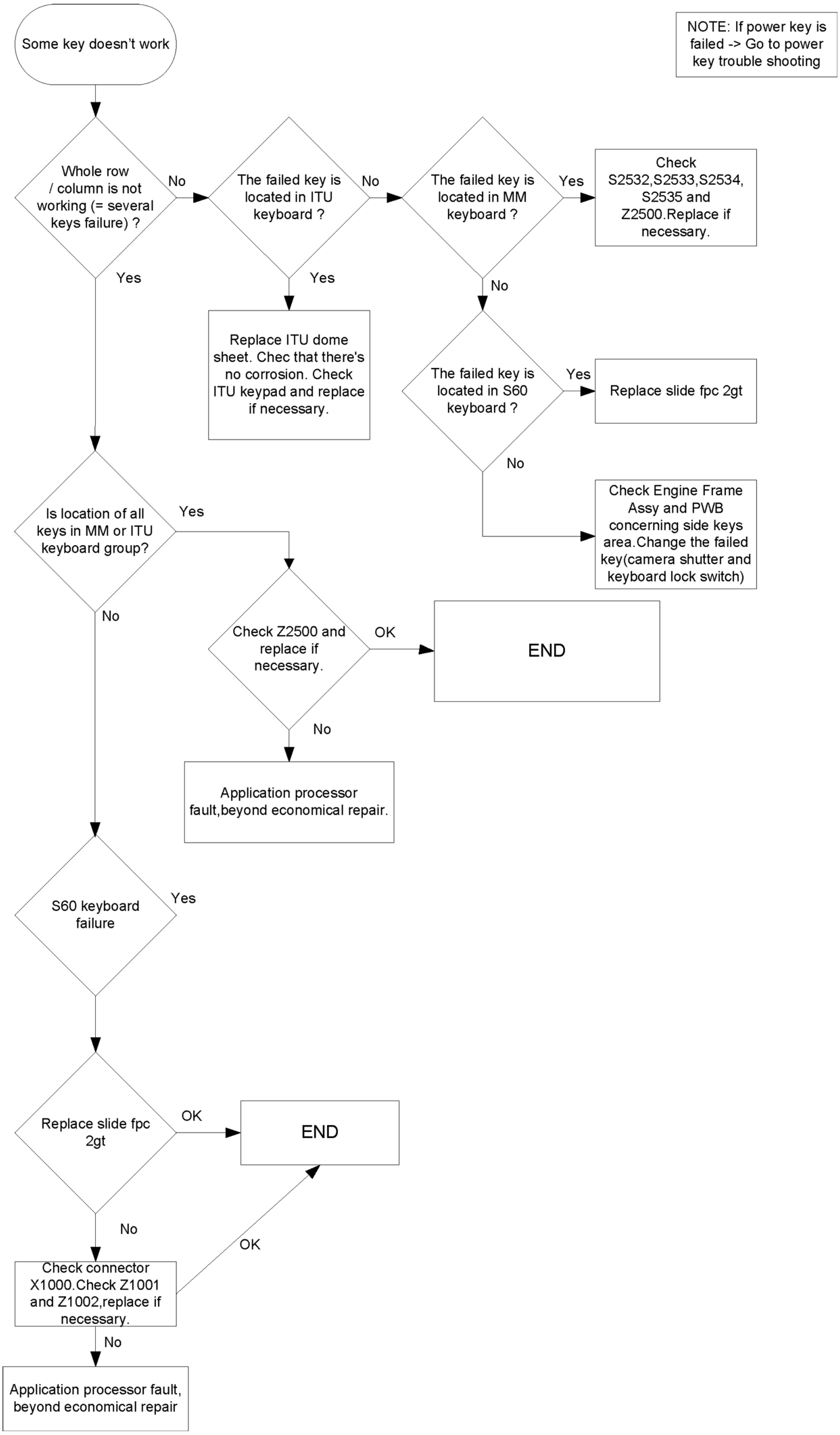
Context

There are two possible failure modes in the keyboard module:

1. One or more keys are stuck, so that the key(s) does not react when you press a keydome. This kind of failure is caused by mechanical reasons (dirt, corrosion).
2. Malfunction of several keys at the same time; this happens when one or more rows or columns are failing (shortcut or open connection). For a more detailed description of the keyboard and keymatrix, see section **Keyboard**.

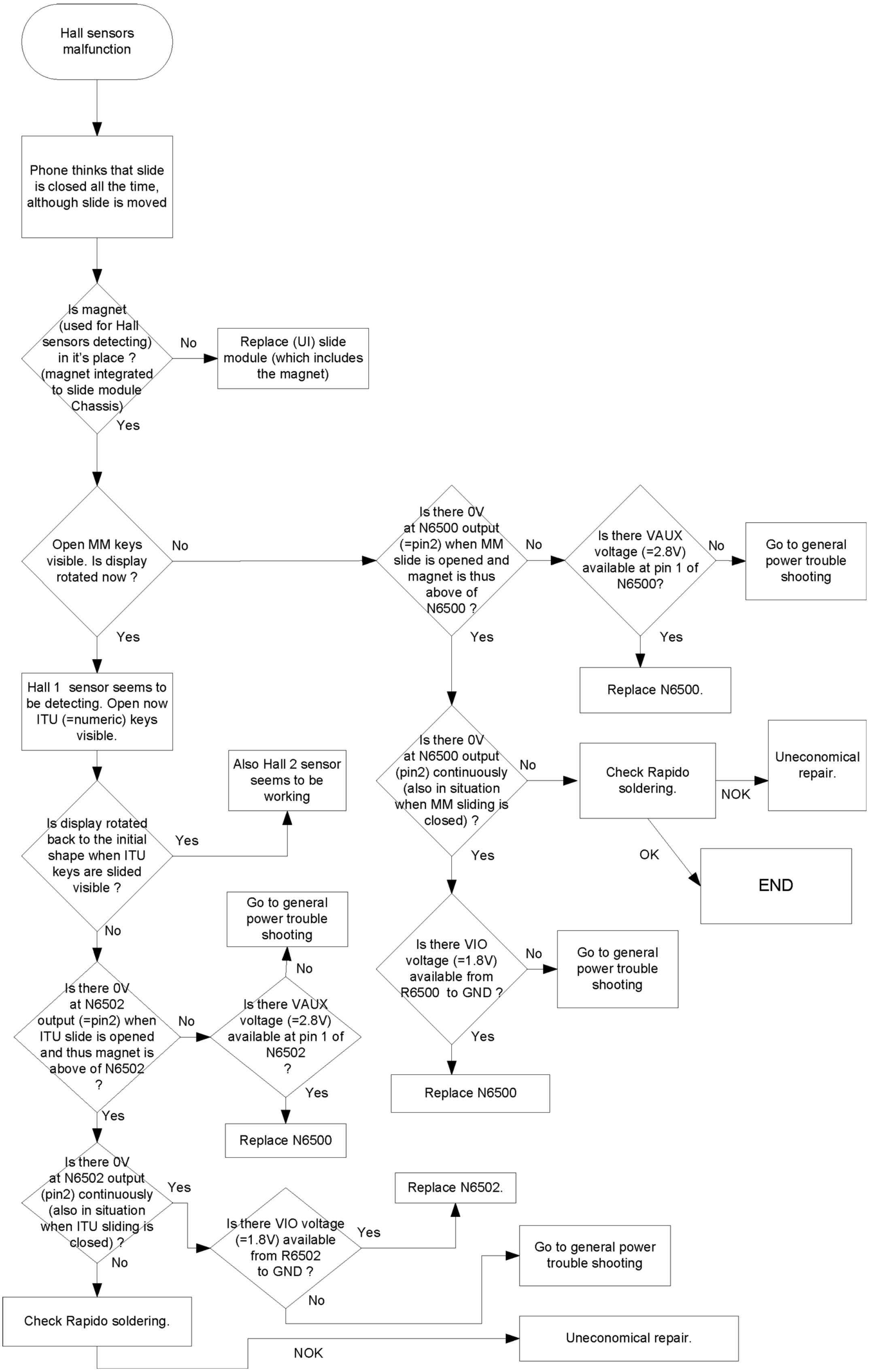
If the failure mode is not clear, start with the **Keyboard Test** in *Phoenix*.

Troubleshooting flow


Some key doesn't work
NOTE: If power key is failed -> Go to power key trouble shooting
Whole row / column is not working (= several keys failure) ?
No
Yes
The failed key is located in ITU keyboard ?
No
Yes
The failed key is located in MM keyboard ?
Yes
No
Check S2532,S2533,S2534, S2535 and Z2500.Replace if necessary.
Replace ITU dome sheet. Chec that there's no corrosion. Check ITU keypad and replace if necessary.
The failed key is located in S60 keyboard ?
Yes
No
Replace slide fpc 2gt
Check Engine Frame Assy and PWB concerning side keys area.Change the failed key(camera shutter and keyboard lock switch)
Is location of all keys in MM or ITU keyboard group?
Yes
No
Check Z2500 and replace if necessary.
OK
No
END
Application processor fault,beyond economical repair.
S60 keyboard failure
Yes
Replace slide fpc 2gt
OK
No
END
OK
Check connector X1000.Check Z1001 and Z1002,replace if necessary.
No
Application processor fault, beyond economical repair

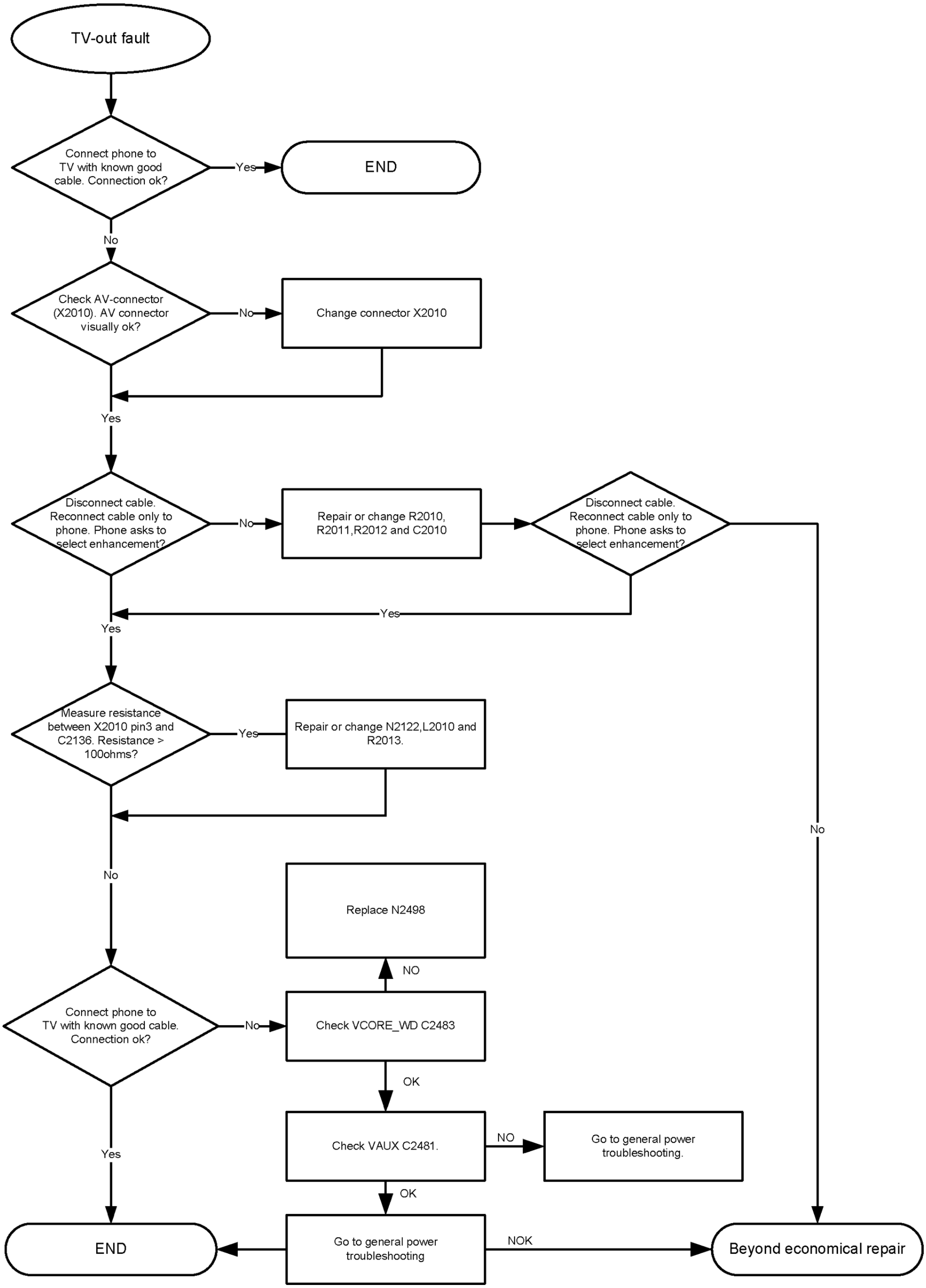
Hall sensor troubleshooting

Troubleshooting flow


Hall sensors malfunction
Phone thinks that slide is closed all the time, although slide is moved
Is magnet (used for Hall sensors detecting) in it's place ? (magnet integrated to slide module Chassis)
No
Replace (UI) slide module (which includes the magnet)
Yes
Open MM keys visible. Is display rotated now ?
No
Is there 0V at N6500 output (=pin2) when MM slide is opened and magnet is thus above of N6500 ?
No
Is there VAUX voltage (=2.8V) available at pin 1 of N6500?
No
Go to general power trouble shooting
Yes
Replace N6500.
Yes
Yes
Hall 1 sensor seems to be detecting. Open now ITU (=numeric) keys visible.
Is display rotated back to the initial shape when ITU keys are slided visible ?
Yes
Also Hall 2 sensor seems to be working
Is there 0V at N6500 output (pin2) continuously (also in situation when MM sliding is closed) ?
No
Check Rapido soldering.
NOK
Uneconomical repair.
OK
END
Yes
Is there VIO voltage (=1.8V) available from R6500 to GND ?
No
Go to general power trouble shooting
Yes
Replace N6500
No
Is there 0V at N6502 output (=pin2) when ITU slide is opened and thus magnet is above of N6502 ?
No
Is there VAUX voltage (=2.8V) available at pin 1 of N6502 ?
No
Go to general power trouble shooting
Yes
Replace N6500
Yes
Is there 0V at N6502 output (pin2) continuously (also in situation when ITU sliding is closed) ?
Yes
Is there VIO voltage (=1.8V) available from R6502 to GND ?
Yes
Replace N6502.
No
Go to general power trouble shooting
No
Check Rapido soldering.
NOK
Uneconomical repair.

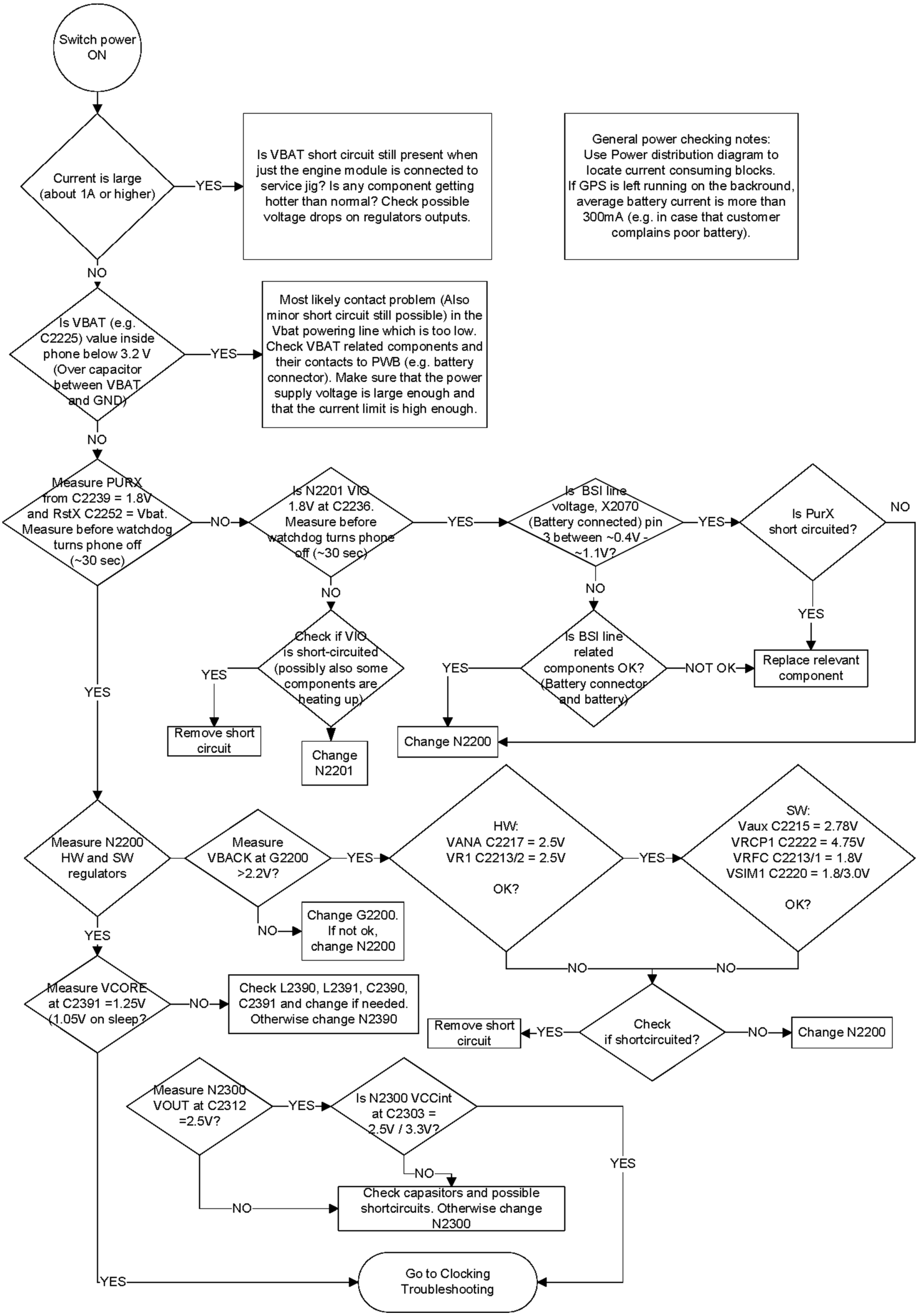
TV- out troubleshooting

Troubleshooting flow


TV-out fault
Connect phone to TV with known good cable. Connection ok?
Yes
END
No
Check AV-connector (X2010). AV connector visually ok?
No
Change connector X2010
Yes
Disconnect cable. Reconnect cable only to phone. Phone asks to select enhancement?
No
Repair or change R2010, R2011,R2012 and C2010
Disconnect cable. Reconnect cable only to phone. Phone asks to select enhancement?
Yes
Yes
No
Measure resistance between X2010 pin3 and C2136. Resistance > 100ohms?
Yes
Repair or change N2122,L2010 and R2013.
No
Replace N2498
NO
Connect phone to TV with known good cable. Connection ok?
No
Check VCORE_WD C2483
OK
Check VAUX C2481.
NO
Go to general power troubleshooting.
OK
Yes
END
Go to general power troubleshooting
NOK
Beyond economical repair

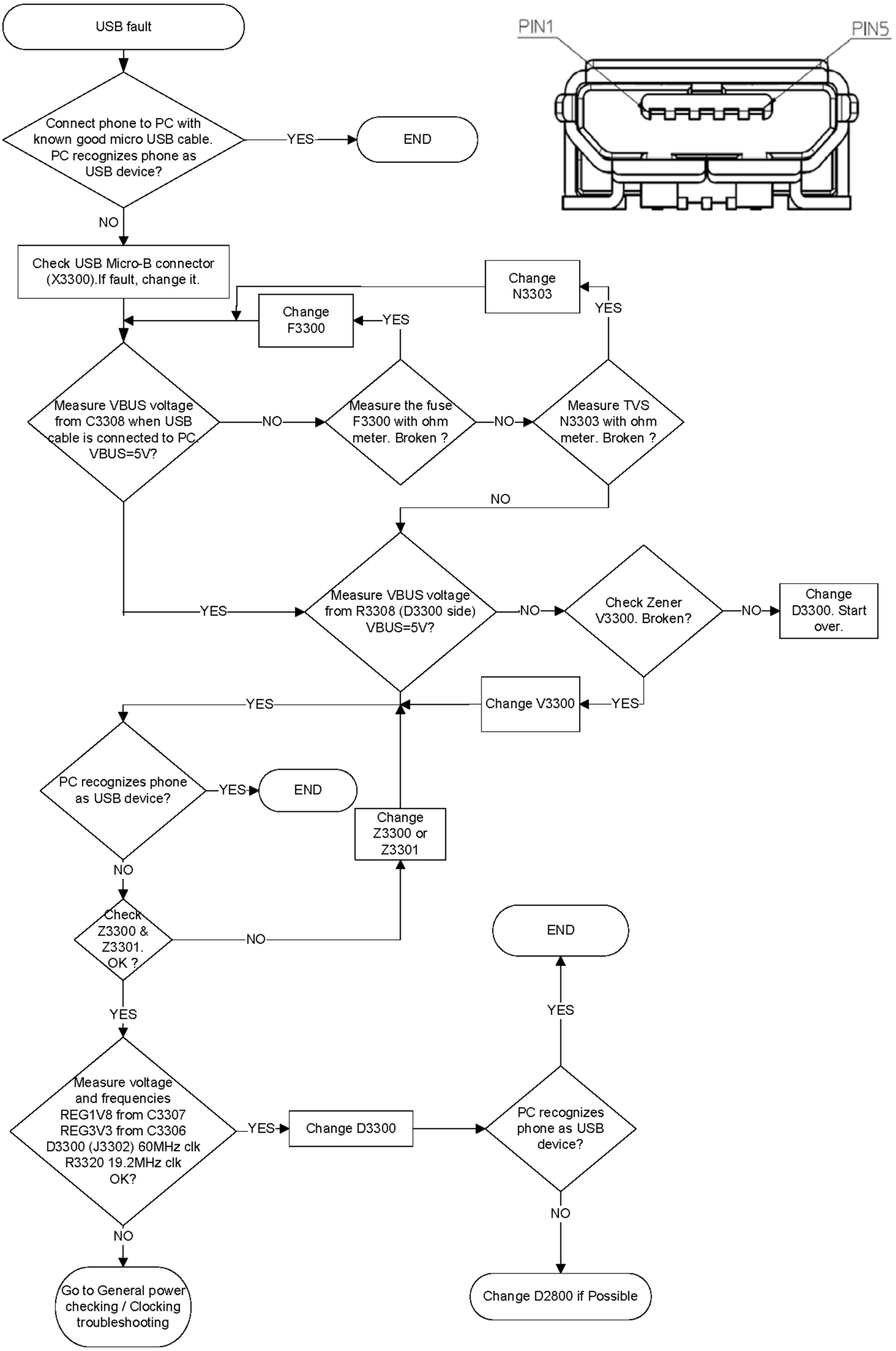
General power checking troubleshooting

Troubleshooting flow


Switch power ON
Current is large (about 1A or higher)
YES
Is VBAT short circuit still present when just the engine module is connected to service jig? Is any component getting hotter than normal? Check possible voltage drops on regulators outputs.
General power checking notes: Use Power distribution diagram to locate current consuming blocks. If GPS is left running on the backround, average battery current is more than 300mA (e.g. in case that customer complains poor battery).
NO
Is VBAT (e.g. C2225) value inside phone below 3.2 V (Over capacitor between VBAT and GND)
YES
Most likely contact problem (Also minor short circuit still possible) in the Vbat powering line which is too low. Check VBAT related components and their contacts to PWB (e.g. battery connector). Make sure that the power supply voltage is large enough and that the current limit is high enough.
NO
Measure PURX from C2239 = 1.8V and RstX C2252 = Vbat. Measure before watchdog turns phone off (~30 sec)
NO
Is N2201 VIO 1.8V at C2236. Measure before watchdog turns phone off (~30 sec)
YES
Is BSI line voltage, X2070 (Battery connected) pin 3 between ~0.4V - ~1.1V?
YES
Is PurX short circuited?
NO
NO
Check if VIO is short-circuited (possibly also some components are heating up)
YES
Remove short circuit
Change N2201
NO
Is BSI line related components OK? (Battery connector and battery)
YES
Change N2200
NOT OK
YES
Replace relevant component
YES
Measure N2200 HW and SW regulators
Measure VBACK at G2200 >2.2V?
YES
HW: VANA C2217 = 2.5V VR1 C2213/2 = 2.5V OK?
YES
SW: Vaux C2215 = 2.78V VRCP1 C2222 = 4.75V VRFC C2213/1 = 1.8V VSIM1 C2220 = 1.8/3.0V OK?
NO
Change G2200. If not ok, change N2200
NO
NO
YES
Measure VCORE at C2391 =1.25V (1.05V on sleep?
NO
Check L2390, L2391, C2390, C2391 and change if needed. Otherwise change N2390
Remove short circuit
YES
Check if shortcircuited?
NO
Change N2200
Measure N2300 VOUT at C2312 =2.5V?
YES
Is N2300 VCCint at C2303 = 2.5V / 3.3V?
NO
Check capasitors and possible shortcircuits. Otherwise change N2300
NO
YES
YES
Go to Clocking Troubleshooting

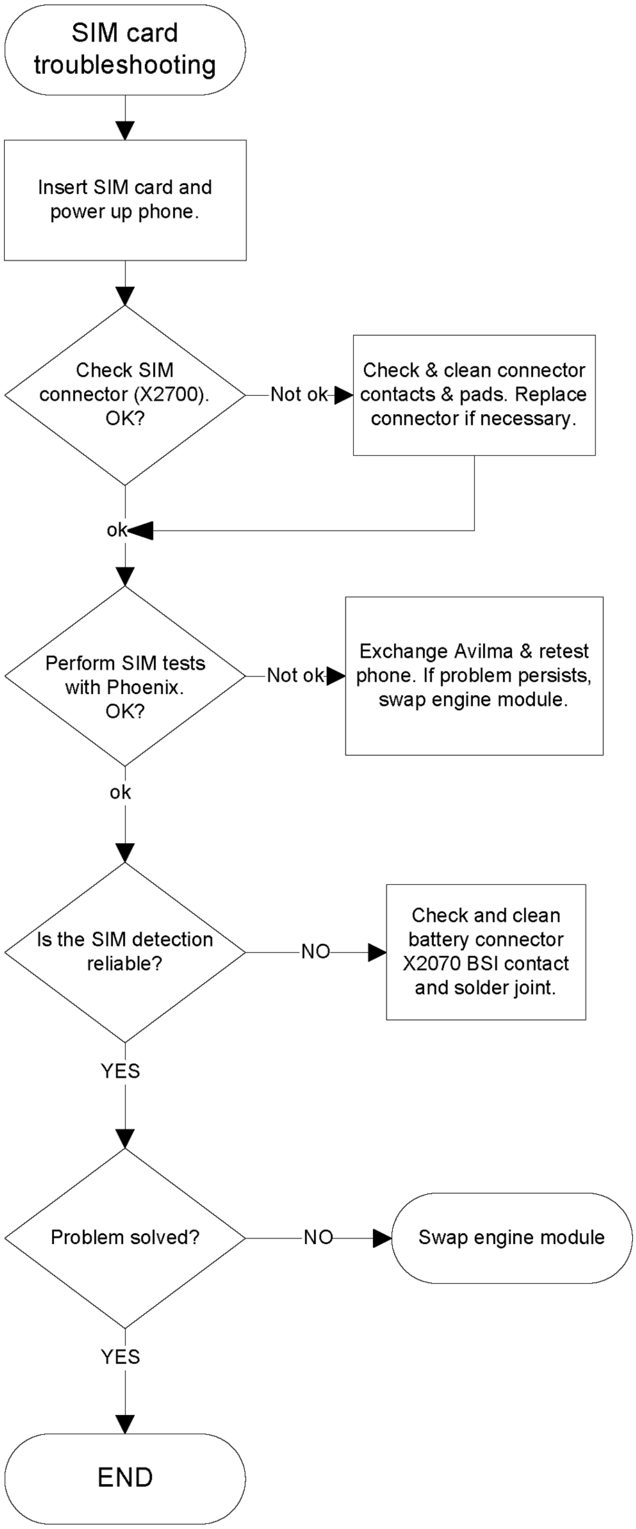
USB troubleshooting

Troubleshooting flow


USB fault
Connect phone to PC with known good micro USB cable. PC recognizes phone as USB device?
YES
END
NO
Check USB Micro-B connector (X3300).If fault, change it.
Change N3303
YES
Change F3300
YES
Measure VBUS voltage from C3308 when USB cable is connected to PC. VBUS=5V?
NO
Measure the fuse F3300 with ohm meter. Broken ?
NO
Measure TVS N3303 with ohm meter. Broken ?
NO
YES
Measure VBUS voltage from R3308 (D3300 side) VBUS=5V?
NO
Check Zener V3300. Broken?
NO
Change D3300. Start over.
YES
Change V3300
YES
PC recognizes phone as USB device?
YES
END
Change Z3300 or Z3301
NO
Check Z3300 & Z3301. OK ?
NO
YES
Measure voltage and frequencies REG1V8 from C3307 REG3V3 from C3306 D3300 (J3302) 60MHz clk R3320 19.2MHz clk OK?
YES
Change D3300
PC recognizes phone as USB device?
YES
END
NO
Change D2800 if Possible
NO
Go to General power checking / Clocking troubleshooting
PIN1
PIN5

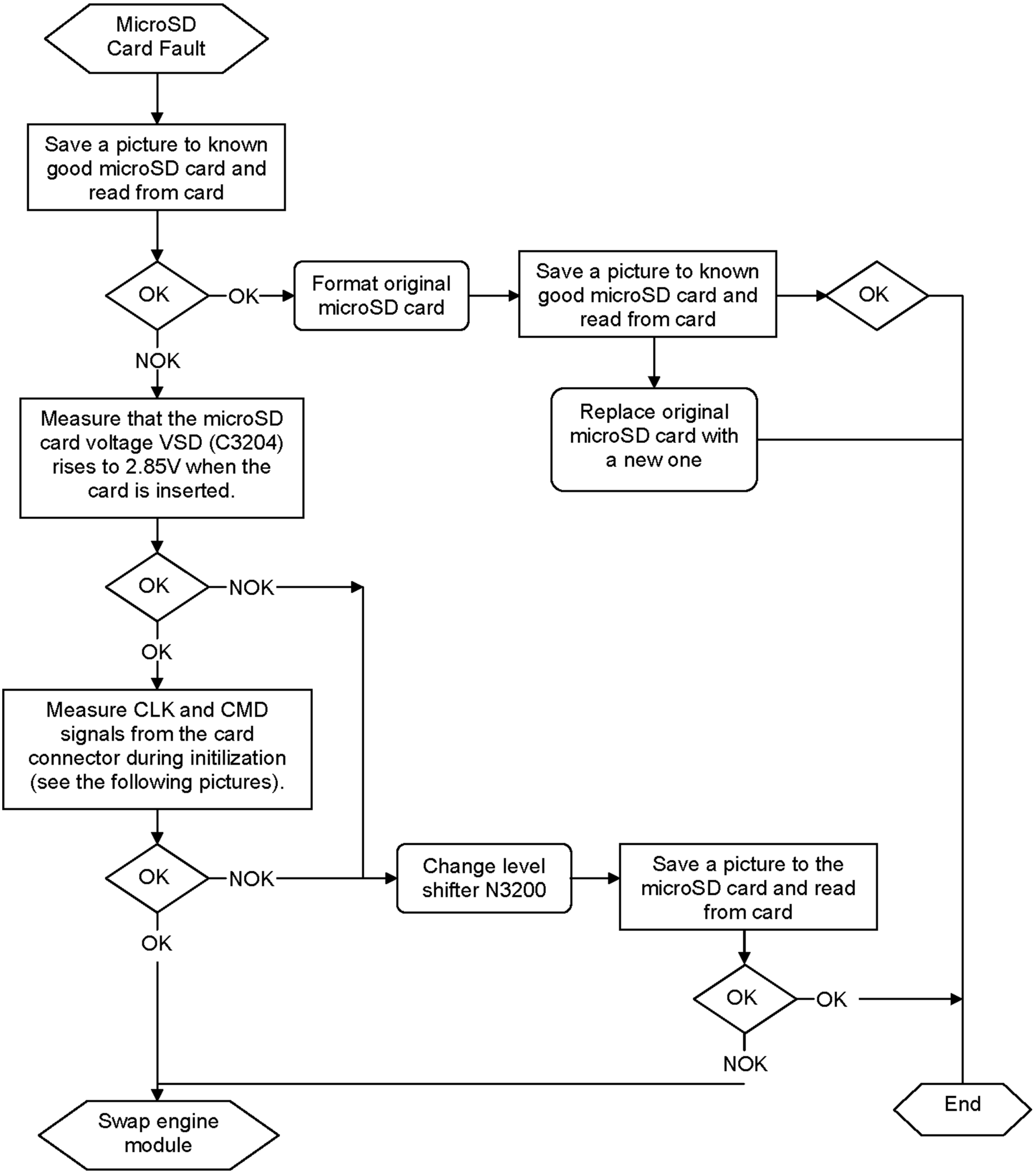
SIM card troubleshooting

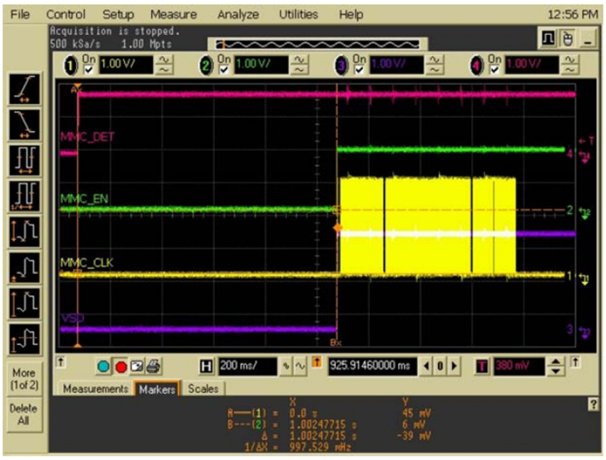
Troubleshooting flow


SIM card troubleshooting
Insert SIM card and power up phone.
Check SIM connector (X2700). OK?
Not ok
Check & clean connector contacts & pads. Replace connector if necessary.
ok
Perform SIM tests with Phoenix. OK?
Not ok
Exchange Avilma & retest phone. If problem persists, swap engine module.
ok
Is the SIM detection reliable?
NO
Check and clean battery connector X2070 BSI contact and solder joint.
YES
Problem solved?
NO
Swap engine module
YES
END

MicroSD card troubleshooting

Troubleshooting flow

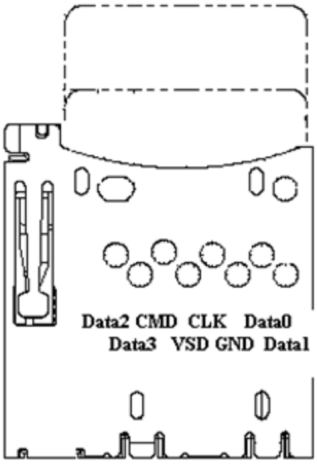

MicroSD Card Fault
Save a picture to known good microSD card and read from card
OK
OK
Format original microSD card
Save a picture to known good microSD card and read from card
OK
Replace original microSD card with a new one
NOK
Measure that the microSD card voltage VSD (C3204) rises to 2.85V when the card is inserted.
OK
NOK
OK
Measure CLK and CMD signals from the card connector during initilization (see the following pictures).
OK
NOK
Change level shifter N3200
Save a picture to the microSD card and read from card
OK
OK
OK
NOK
Swap engine module
End


File Control Setup Measure Analyze Utilities Help
12:56 PM
1.00 V/
1.00 V/
1.00 V/
1.00 V/
MMC_DET
MMC_EN
MMC_CLK
VSD
200 ms/
925.91460000 ms
380 mV
Measurements Markers Scales
More (1of 2)
Delete All

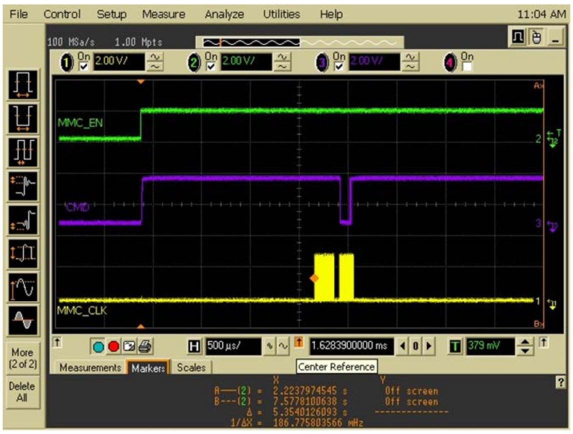
```
Acquisition is stopped.
500 kSa/s    1.00 Mpts
```

```
                X                       Y
A——(1) =   0.0 s                      45 mV
B---(2) =  1.00247715 s                6 mV
     Δ =   1.00247715 s              -39 mV
  1/ΔX =   997.529 mHz
```

MicroSD interface signals timing when card is inserted.


Data2 CMD CLK Data0
Data3 VSD GND Data1

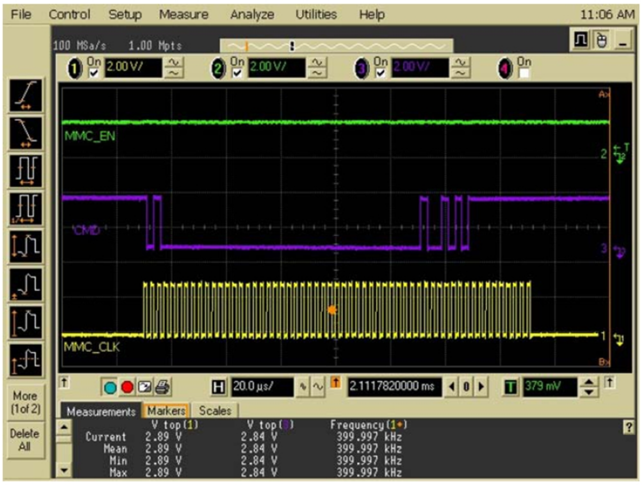
MicroSD connector


File Control Setup Measure Analyze Utilities Help
11:04 AM
2.00 V/
2.00 V/
2.00 V/
MMC_EN
CMD
MMC_CLK
500 µs/
1.6283900000 ms
379 mV
Center Reference
Measurements Markers Scales
More (2 of 2)
Delete All

```
100 MSa/s    1.00 Mpts
```

```
                X                       Y
A——(2) =   2.2237974545 s         Off screen
B---(2) =  7.5778100638 s         Off screen
     Δ =   5.3540126093 s       --------------
  1/ΔX =   186.775803566 mHz
```

CLK and CMD signals during card initialisation when card is not inserted. Measured from the microSD connector.


File Control Setup Measure Analyze Utilities Help
11:06 AM
2.00 V/
2.00 V/
2.00 V/
MMC_EN
CMD
MMC_CLK
20.0 µs/
2.1117820000 ms
379 mV
Measurements Markers Scales
More (1of 2)
Delete All

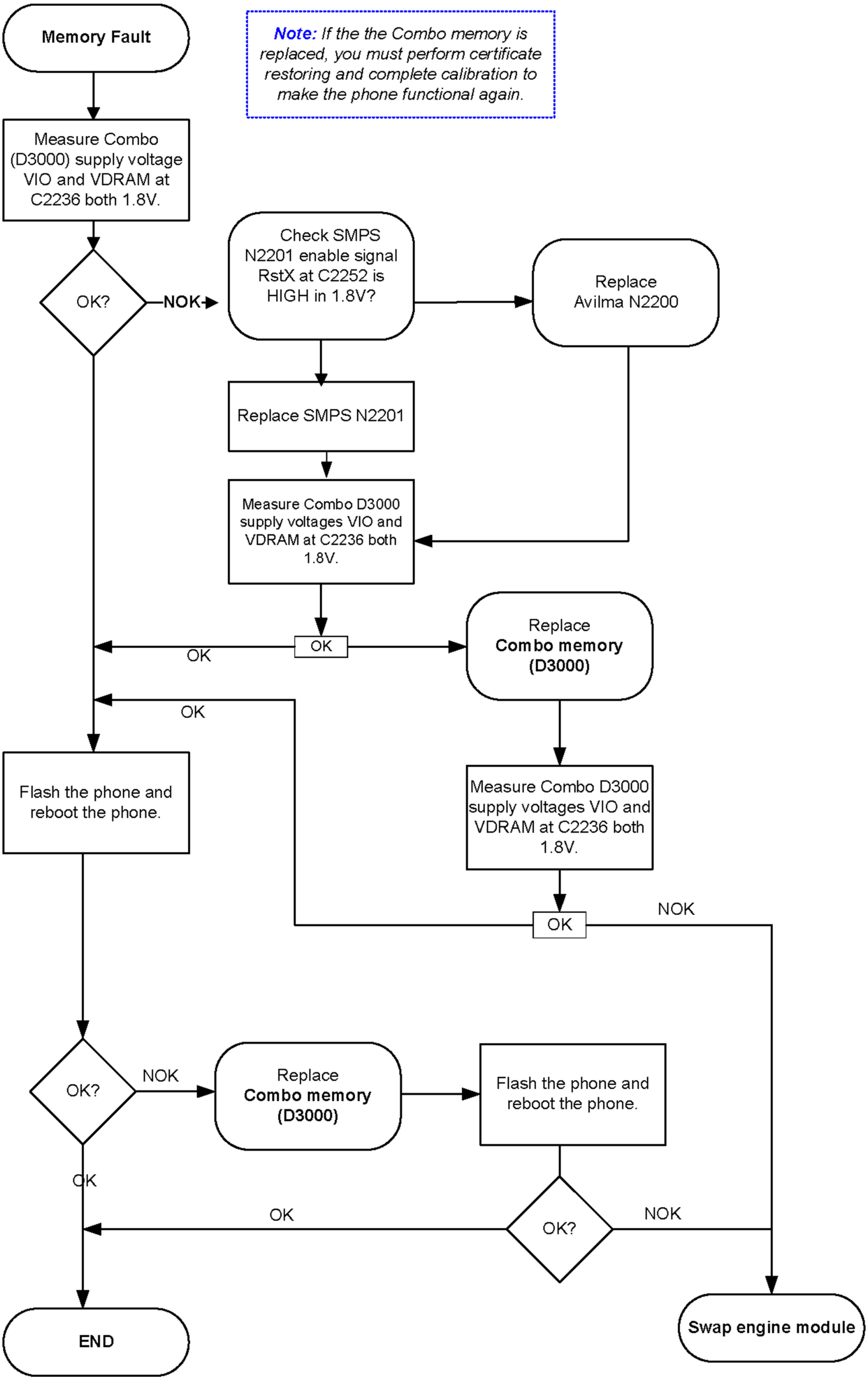
```
100 MSa/s    1.00 Mpts
```

```
           V top(1)      V top( )      Frequency(1)
Current    2.89 V        2.84 V        399.997 kHz
   Mean    2.89 V        2.84 V        399.997 kHz
    Min    2.89 V        2.84 V        399.997 kHz
    Max    2.89 V        2.84 V        399.997 kHz
```

CLK and CMD signals during card initialisation when card is not inserted. Measured from the microSD connector

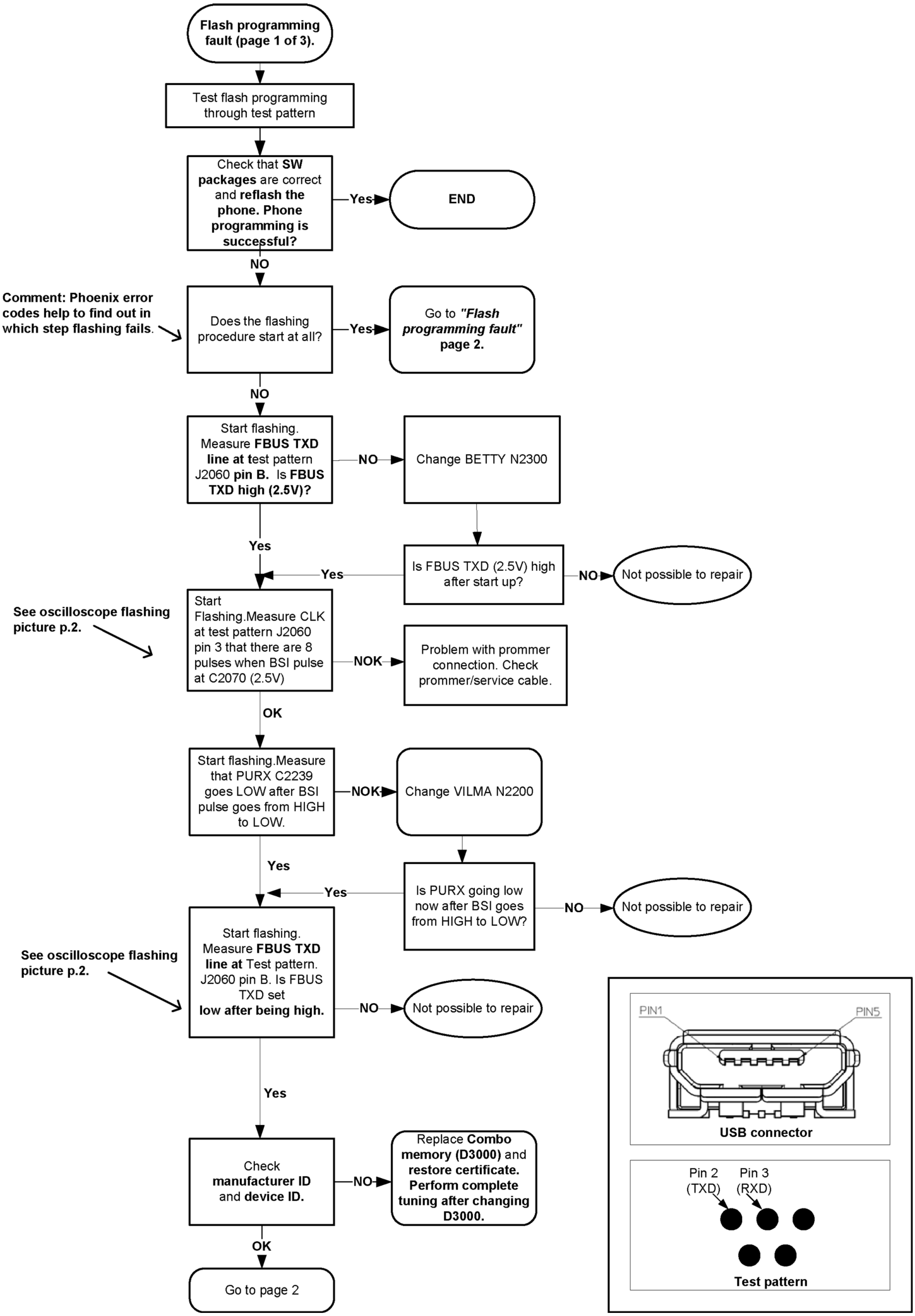
Combo memory troubleshooting

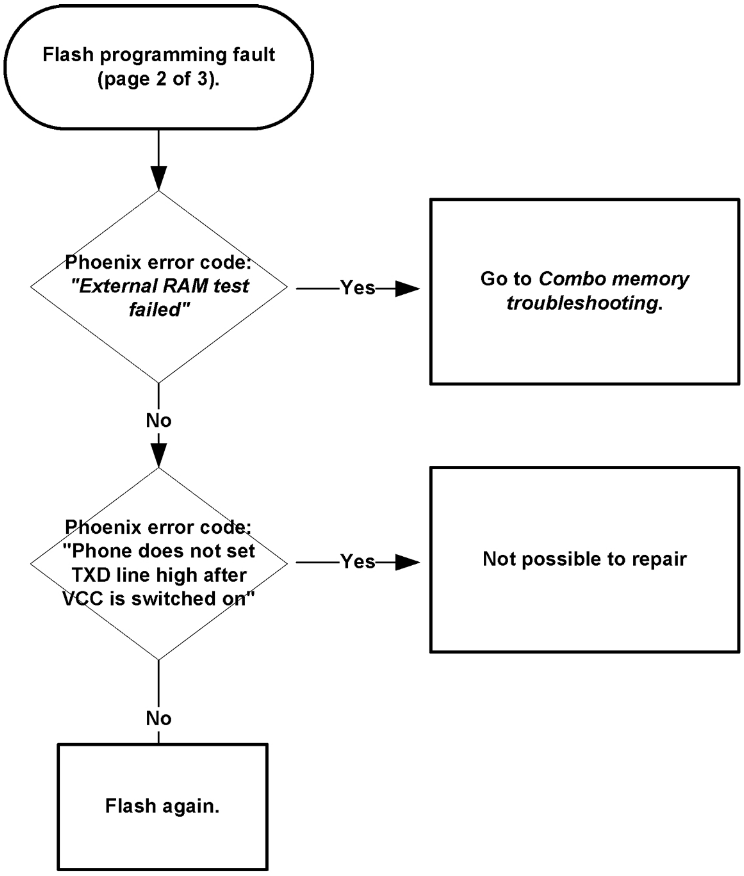
Troubleshooting flow

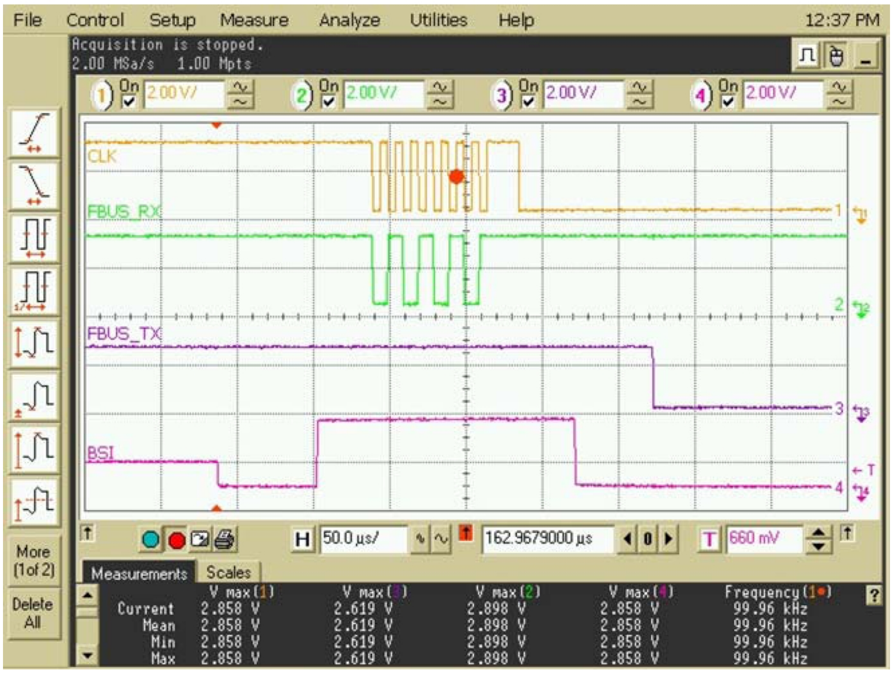

Memory Fault
Note: If the the Combo memory is replaced, you must perform certificate restoring and complete calibration to make the phone functional again.
Measure Combo (D3000) supply voltage VIO and VDRAM at C2236 both 1.8V.
OK?
NOK
Check SMPS N2201 enable signal RstX at C2252 is HIGH in 1.8V?
Replace Avilma N2200
Replace SMPS N2201
Measure Combo D3000 supply voltages VIO and VDRAM at C2236 both 1.8V.
OK
OK
Replace Combo memory (D3000)
OK
Flash the phone and reboot the phone.
Measure Combo D3000 supply voltages VIO and VDRAM at C2236 both 1.8V.
OK
NOK
OK?
NOK
Replace Combo memory (D3000)
Flash the phone and reboot the phone.
OK
OK
OK?
NOK
END
Swap engine module

Flash programming troubleshooting

Troubleshooting flow

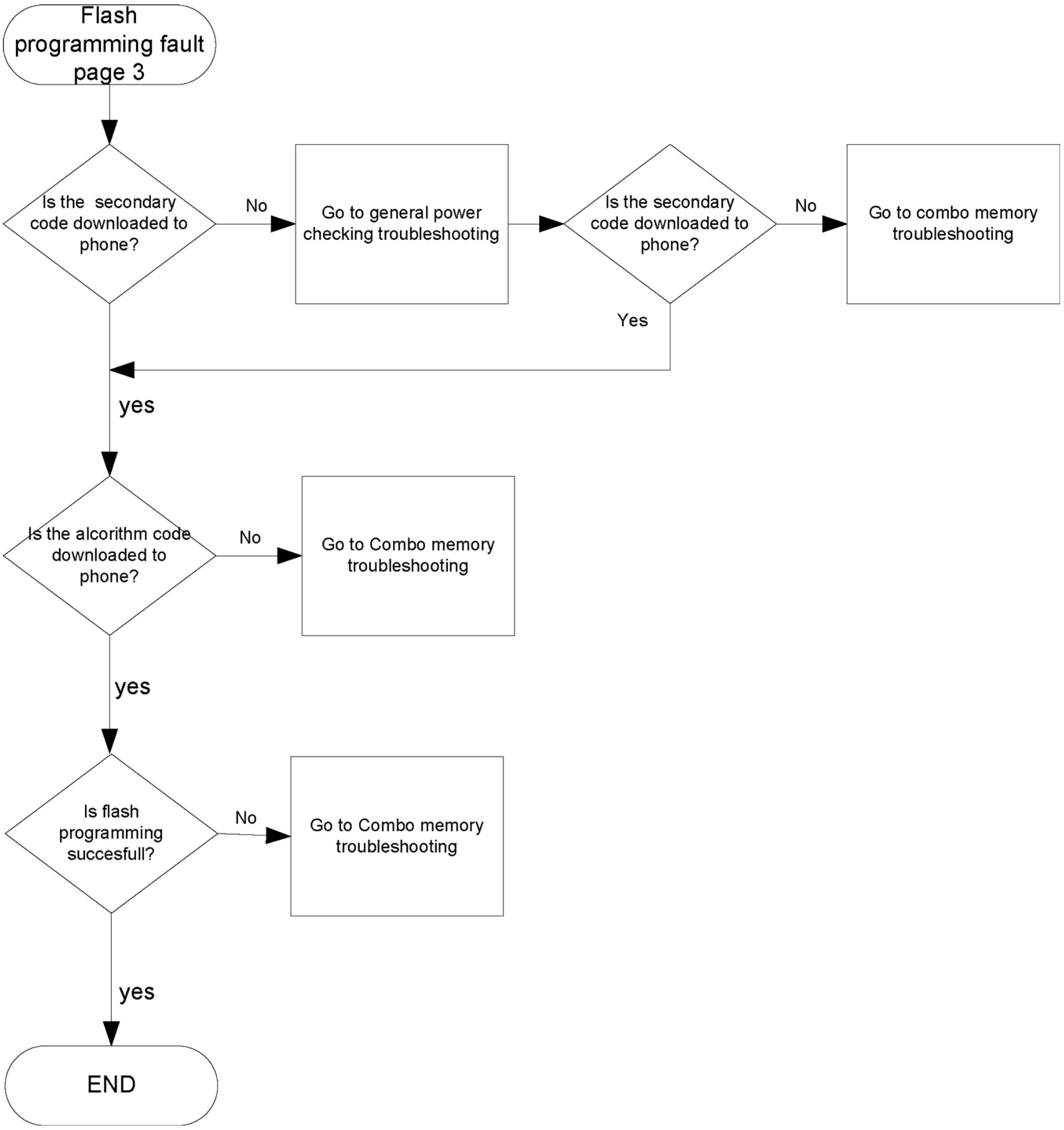

Flash programming fault (page 1 of 3).
Test flash programming through test pattern
Check that SW packages are correct and reflash the phone. Phone programming is successful?
Yes
END
NO
Comment: Phoenix error codes help to find out in which step flashing fails.
Does the flashing procedure start at all?
Yes
Go to "Flash programming fault" page 2.
NO
Start flashing. Measure FBUS TXD line at test pattern J2060 pin B. Is FBUS TXD high (2.5V)?
NO
Change BETTY N2300
Is FBUS TXD (2.5V) high after start up?
NO
Not possible to repair
Yes
Yes
See oscilloscope flashing picture p.2.
Start Flashing.Measure CLK at test pattern J2060 pin 3 that there are 8 pulses when BSI pulse at C2070 (2.5V)
NOK
Problem with prommer connection. Check prommer/service cable.
OK
Start flashing.Measure that PURX C2239 goes LOW after BSI pulse goes from HIGH to LOW.
NOK
Change VILMA N2200
Is PURX going low now after BSI goes from HIGH to LOW?
NO
Not possible to repair
Yes
Yes
See oscilloscope flashing picture p.2.
Start flashing. Measure FBUS TXD line at Test pattern. J2060 pin B. Is FBUS TXD set low after being high.
NO
Not possible to repair
Yes
Check manufacturer ID and device ID.
NO
Replace Combo memory (D3000) and restore certificate. Perform complete tuning after changing D3000.
OK
Go to page 2
PIN1
PIN5
USB connector
Pin 2 (TXD)
Pin 3 (RXD)
Test pattern


Flash programming fault (page 2 of 3).
Phoenix error code: *"External RAM test failed"*
Yes
Go to *Combo memory troubleshooting.*
No
Phoenix error code: "Phone does not set TXD line high after VCC is switched on"
Yes
Not possible to repair
No
Flash again.


File
Control
Setup
Measure
Analyze
Utilities
Help
12:37 PM
1
On
2.00 V/
2
On
2.00 V/
3
On
2.00 V/
4
On
2.00 V/
CLK
FBUS_RX
FBUS_TX
BSI
1
2
3
4
T
H
50.0 µs/
162.9679000 µs
0
T
660 mV
More (1 of 2)
Delete All
Measurements
Scales

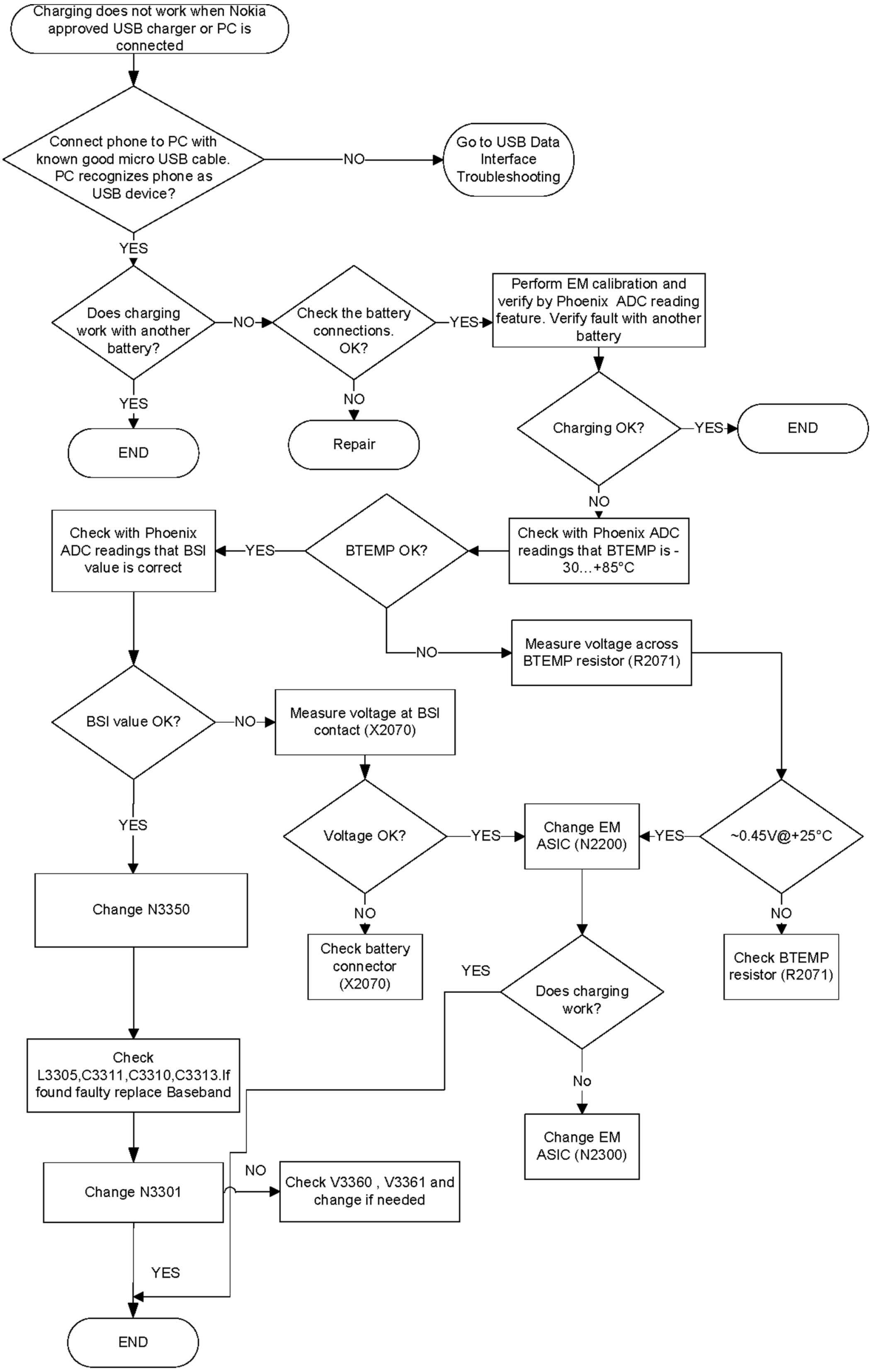
```
Acquisition is stopped.
2.00 MSa/s   1.00 Mpts
```

```
          V max(1)   V max(3)   V max(2)   V max(4)   Frequency(1)
Current   2.858 V    2.619 V    2.898 V    2.858 V     99.96 kHz
   Mean   2.858 V    2.619 V    2.898 V    2.858 V     99.96 kHz
    Min   2.858 V    2.619 V    2.898 V    2.858 V     99.96 kHz
    Max   2.858 V    2.619 V    2.898 V    2.858 V     99.96 kHz
```


Flash programming fault page 3
Is the secondary code downloaded to phone?
No
Go to general power checking troubleshooting
Is the secondary code downloaded to phone?
No
Go to combo memory troubleshooting
Yes
yes
Is the alcorithm code downloaded to phone?
No
Go to Combo memory troubleshooting
yes
Is flash programming succesfull?
No
Go to Combo memory troubleshooting
yes
END

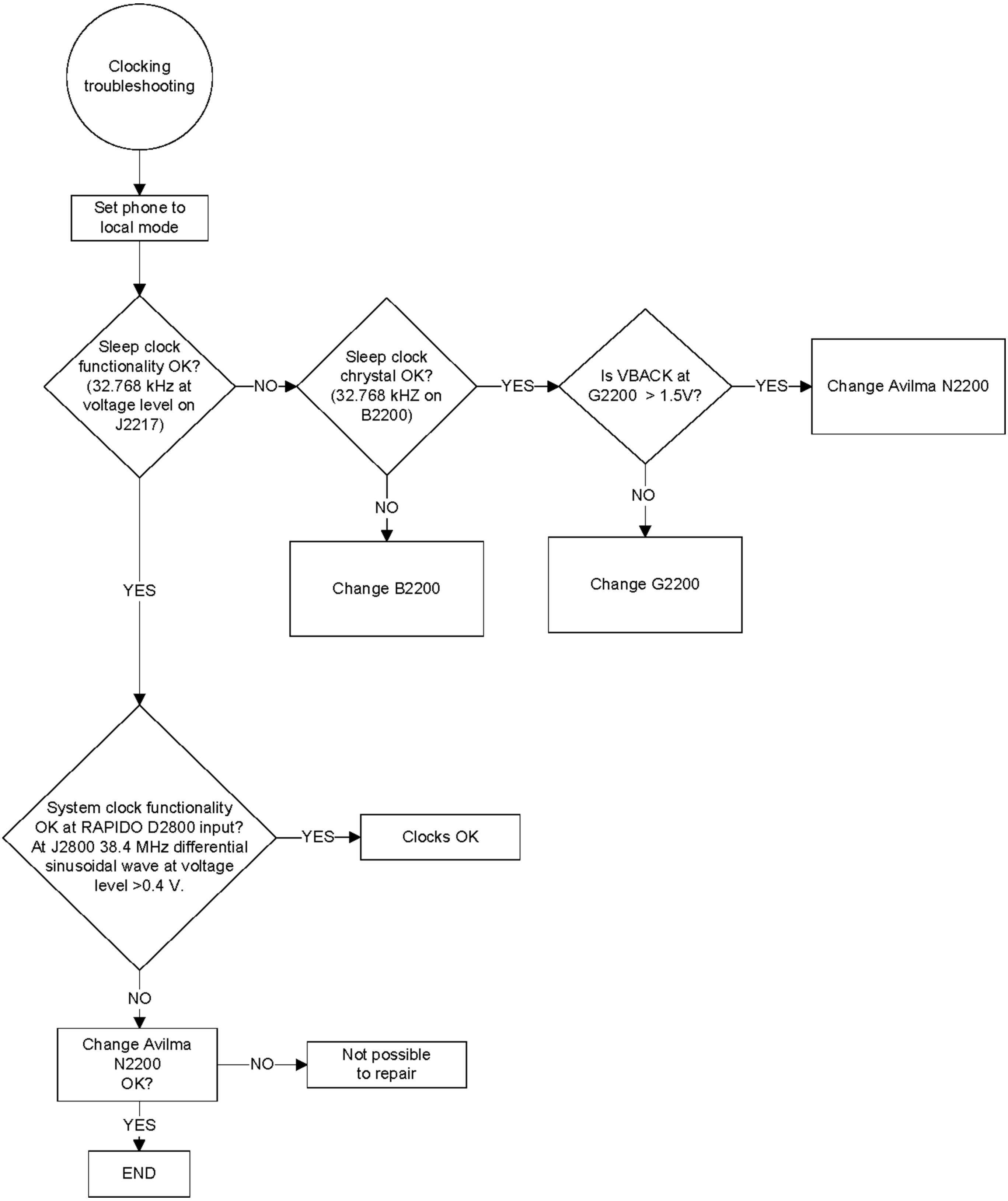
USB charging troubleshooting

Troubleshooting flow


Charging does not work when Nokia approved USB charger or PC is connected
Connect phone to PC with known good micro USB cable. PC recognizes phone as USB device?
NO
Go to USB Data Interface Troubleshooting
YES
Does charging work with another battery?
NO
Check the battery connections. OK?
YES
Perform EM calibration and verify by Phoenix ADC reading feature. Verify fault with another battery
YES
END
NO
Repair
Charging OK?
YES
END
NO
Check with Phoenix ADC readings that BTEMP is -30…+85°C
BTEMP OK?
YES
Check with Phoenix ADC readings that BSI value is correct
NO
Measure voltage across BTEMP resistor (R2071)
BSI value OK?
NO
Measure voltage at BSI contact (X2070)
Voltage OK?
YES
Change EM ASIC (N2200)
YES
~0.45V@+25°C
NO
Check battery connector (X2070)
NO
Check BTEMP resistor (R2071)
YES
Change N3350
YES
Does charging work?
No
Change EM ASIC (N2300)
Check L3305,C3311,C3310,C3313.If found faulty replace Baseband
Change N3301
NO
Check V3360 , V3361 and change if needed
YES
END

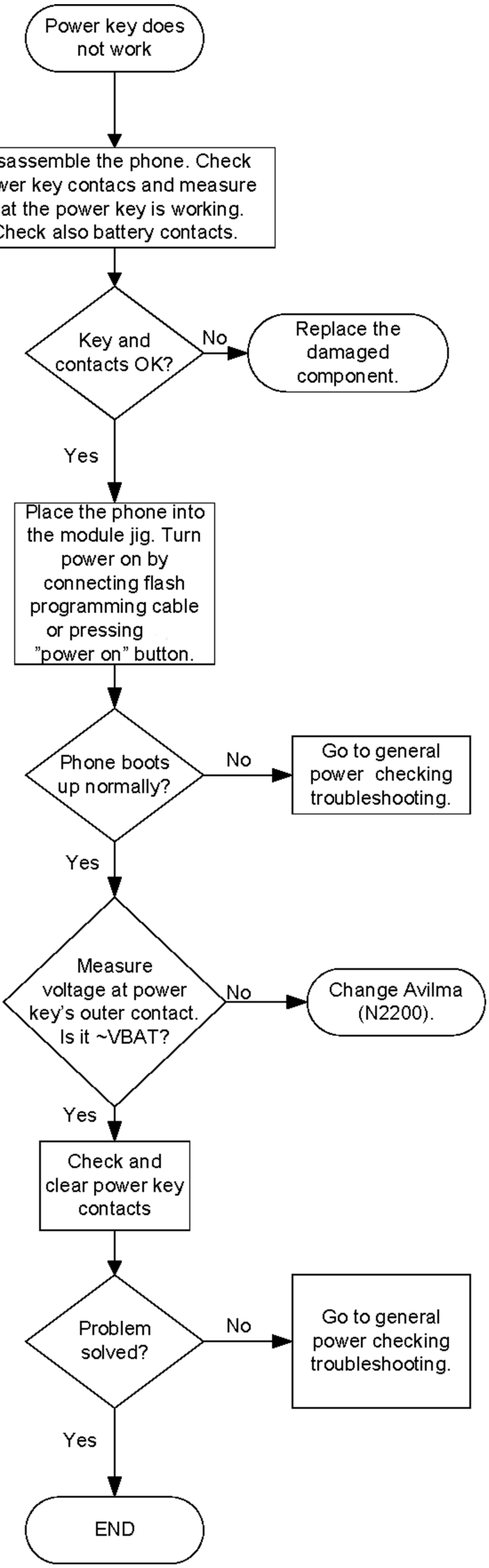
Clocking troubleshooting

Troubleshooting flow


Clocking troubleshooting
Set phone to local mode
Sleep clock functionality OK? (32.768 kHz at voltage level on J2217)
NO
Sleep clock chrystal OK? (32.768 kHZ on B2200)
YES
Is VBACK at G2200 > 1.5V?
YES
Change Avilma N2200
NO
Change B2200
NO
Change G2200
YES
System clock functionality OK at RAPIDO D2800 input? At J2800 38.4 MHz differential sinusoidal wave at voltage level >0.4 V.
YES
Clocks OK
NO
Change Avilma N2200 OK?
NO
Not possible to repair
YES
END

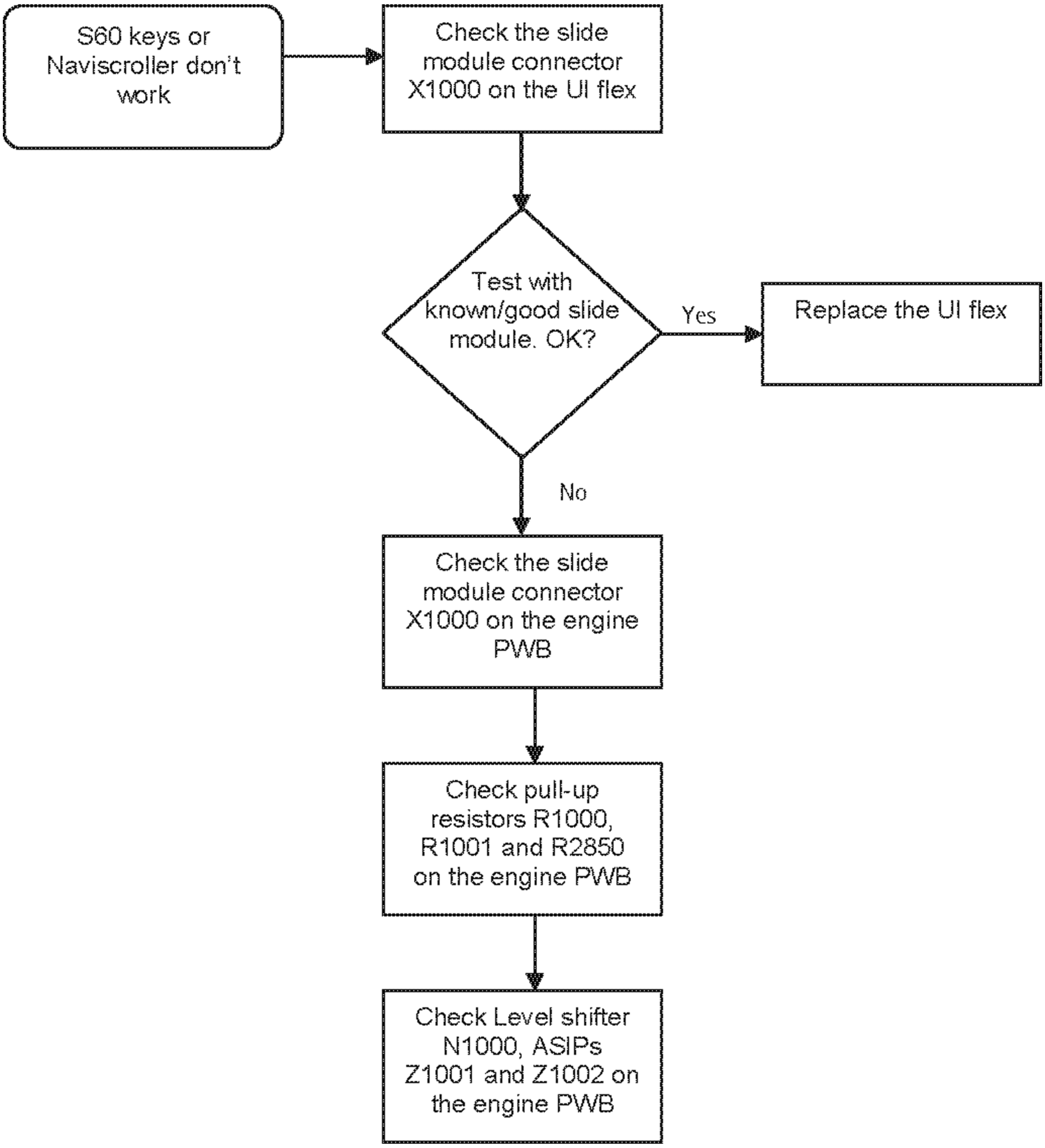
Power key troubleshooting

Troubleshooting flow


Power key does not work
Disassemble the phone. Check power key contacs and measure that the power key is working. Check also battery contacts.
Key and contacts OK?
No
Replace the damaged component.
Yes
Place the phone into the module jig. Turn power on by connecting flash programming cable or pressing "power on" button.
Phone boots up normally?
No
Go to general power checking troubleshooting.
Yes
Measure voltage at power key's outer contact. Is it ~VBAT?
No
Change Avilma (N2200).
Yes
Check and clear power key contacts
Problem solved?
No
Go to general power checking troubleshooting.
Yes
END

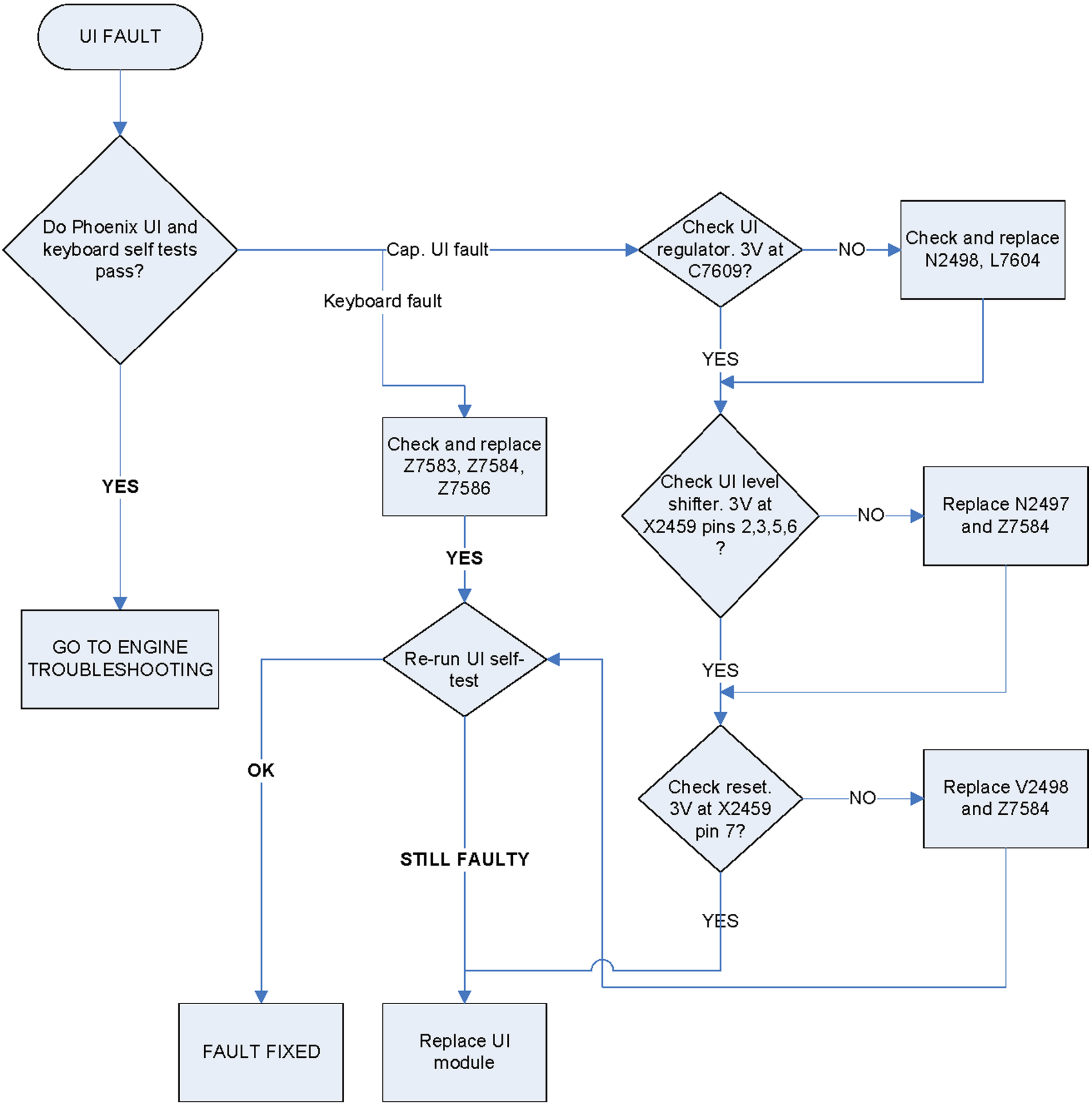
Naviscroll troubleshooting

Troubleshooting flow


S60 keys or Naviscroller don't work
Check the slide module connector X1000 on the UI flex
Test with known/good slide module. OK?
Yes
Replace the UI flex
No
Check the slide module connector X1000 on the engine PWB
Check pull-up resistors R1000, R1001 and R2850 on the engine PWB
Check Level shifter N1000, ASIPs Z1001 and Z1002 on the engine PWB

User interface troubleshooting

Troubleshooting flow


UI FAULT
Do Phoenix UI and keyboard self tests pass?
Cap. UI fault
Keyboard fault
YES
GO TO ENGINE TROUBLESHOOTING
Check UI regulator. 3V at C7609?
NO
Check and replace N2498, L7604
YES
Check and replace Z7583, Z7584, Z7586
YES
Check UI level shifter. 3V at X2459 pins 2,3,5,6 ?
NO
Replace N2497 and Z7584
Re-run UI self-test
YES
OK
Check reset. 3V at X2459 pin 7?
NO
Replace V2498 and Z7584
STILL FAULTY
YES
FAULT FIXED
Replace UI module

Note: If you replace the UI module, you must follow the procedure to ensure that the correct front panel is attached, and that it has been attached properly.

Display Troubleshooting

Display Troubleshooting

Display blank

There is no image on the display. Display looks the same as if the phone is off even when the phone is on.

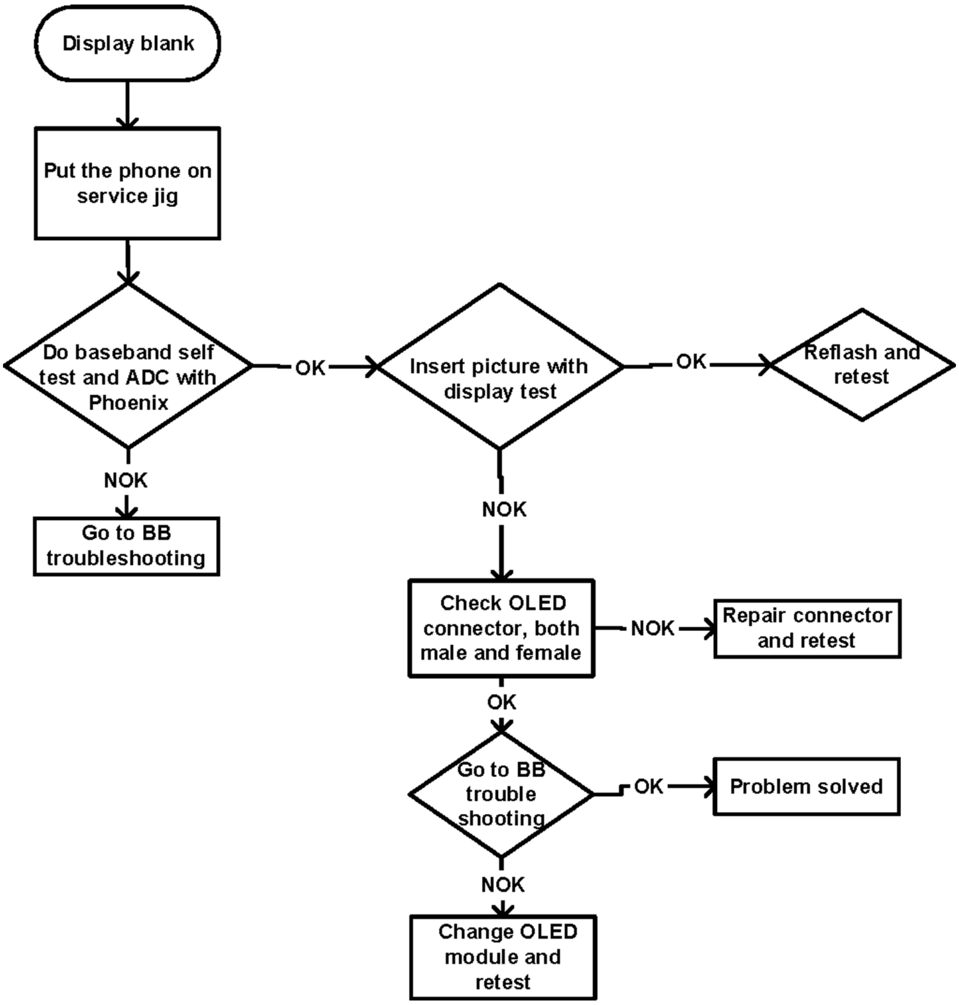
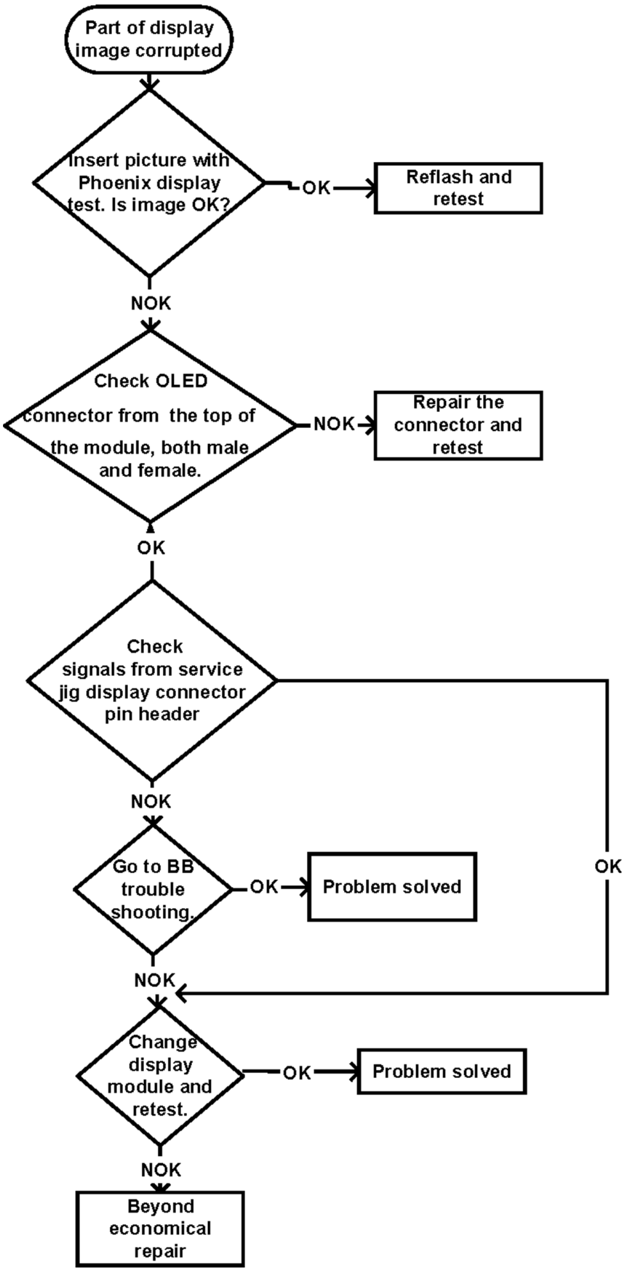

Display blank
Put the phone on service jig
Do baseband self test and ADC with Phoenix
OK
Insert picture with display test
OK
Reflash and retest
NOK
Go to BB troubleshooting
NOK
Check OLED connector, both male and female
NOK
Repair connector and retest
OK
Go to BB trouble shooting
OK
Problem solved
NOK
Change OLED module and retest

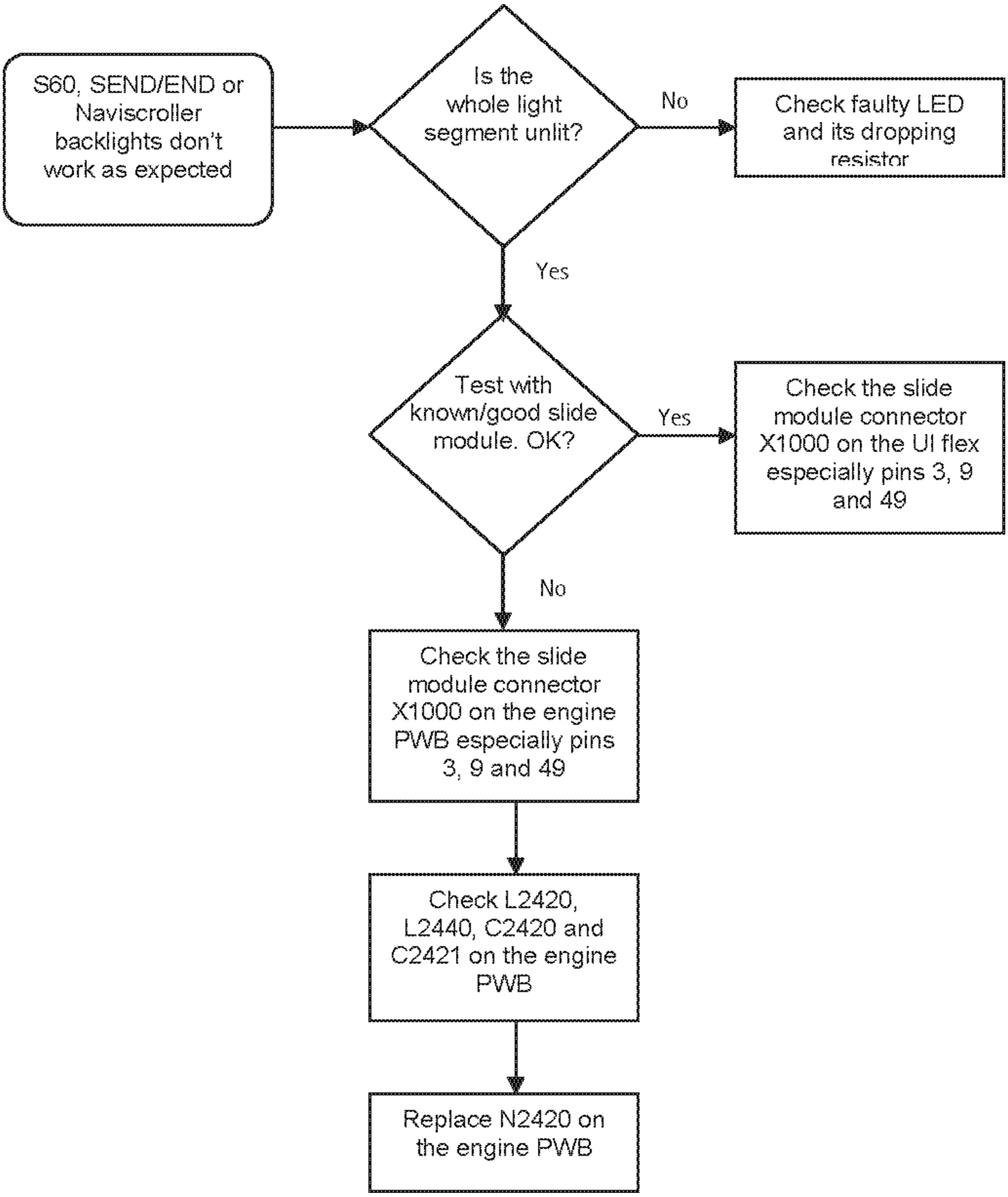
Image on display not correct

Image on the display can be corrupted or part of the image can be missing. If part of image is missing change the UI module. If the image is otherwise corrupted, follow the path below.

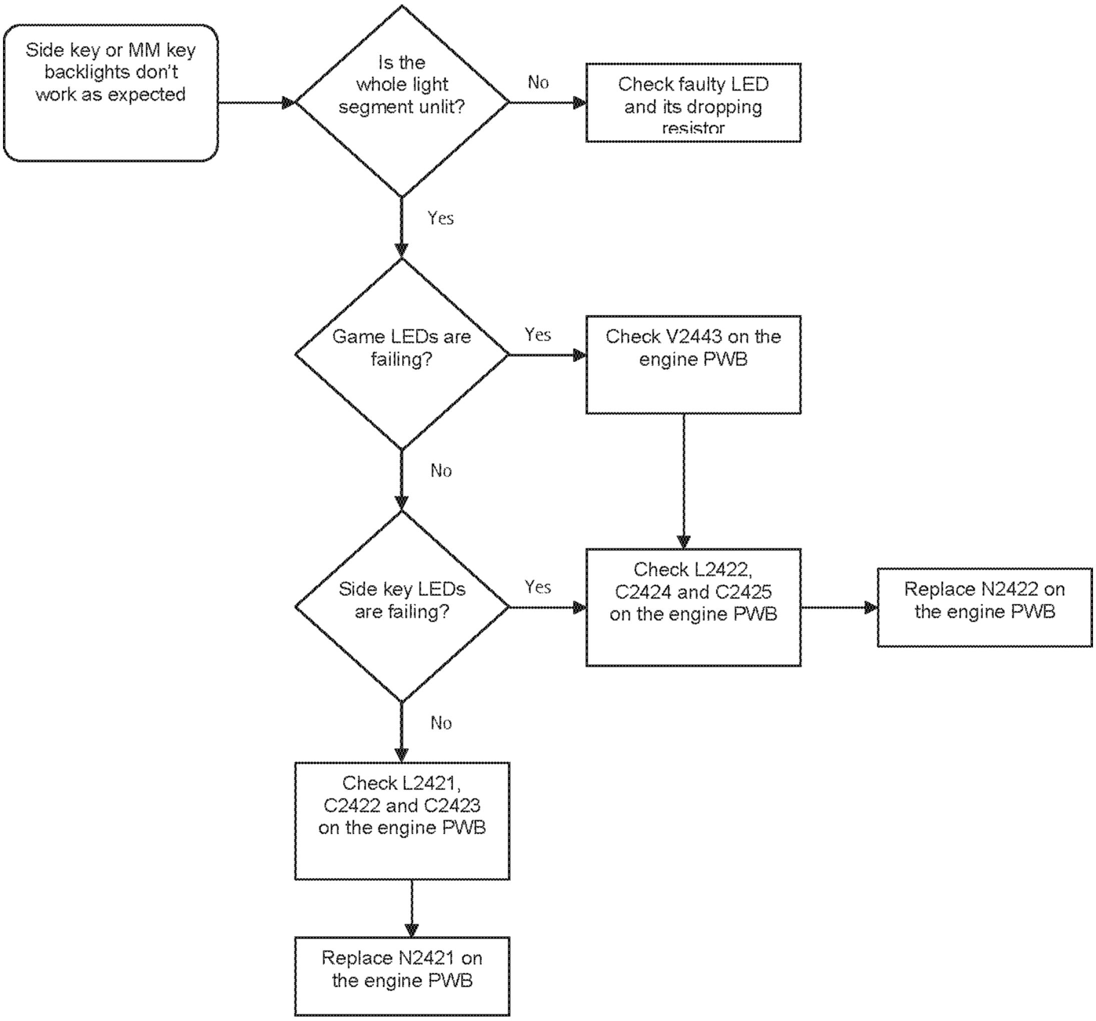

Part of display image corrupted
Insert picture with Phoenix display test. Is image OK?
OK
Reflash and retest
NOK
Check OLED connector from the top of the module, both male and female.
NOK
Repair the connector and retest
OK
Check signals from service jig display connector pin header
OK
NOK
Go to BB trouble shooting.
OK
Problem solved
NOK
Change display module and retest.
OK
Problem solved
NOK
Beyond economical repair

Illumination troubleshooting

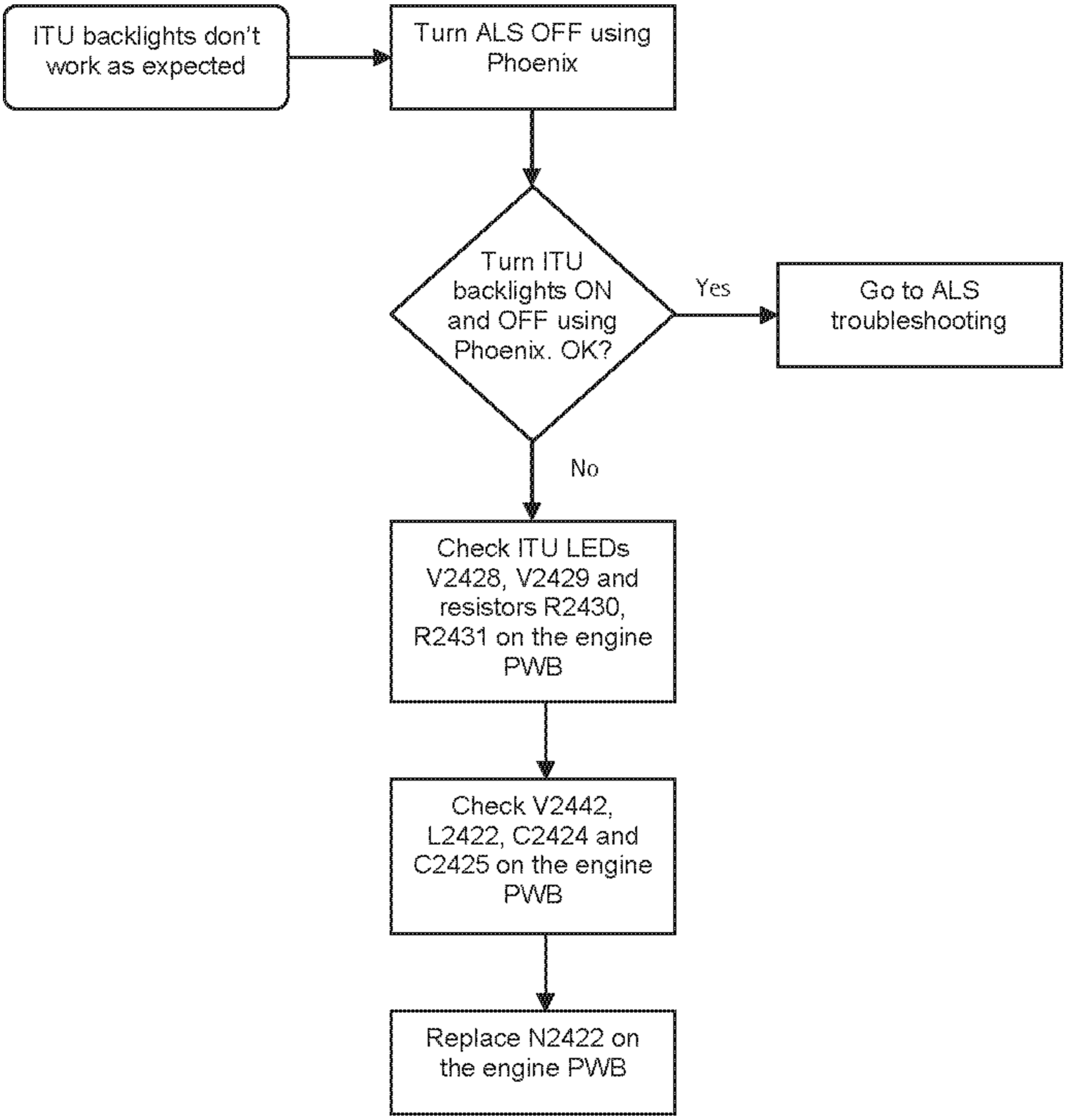
Troubleshooting flow


S60, SEND/END or Naviscroller backlights don't work as expected
Is the whole light segment unlit?
No
Check faulty LED and its dropping resistor
Yes
Test with known/good slide module. OK?
Yes
Check the slide module connector X1000 on the UI flex especially pins 3, 9 and 49
No
Check the slide module connector X1000 on the engine PWB especially pins 3, 9 and 49
Check L2420, L2440, C2420 and C2421 on the engine PWB
Replace N2420 on the engine PWB

Troubleshooting flow

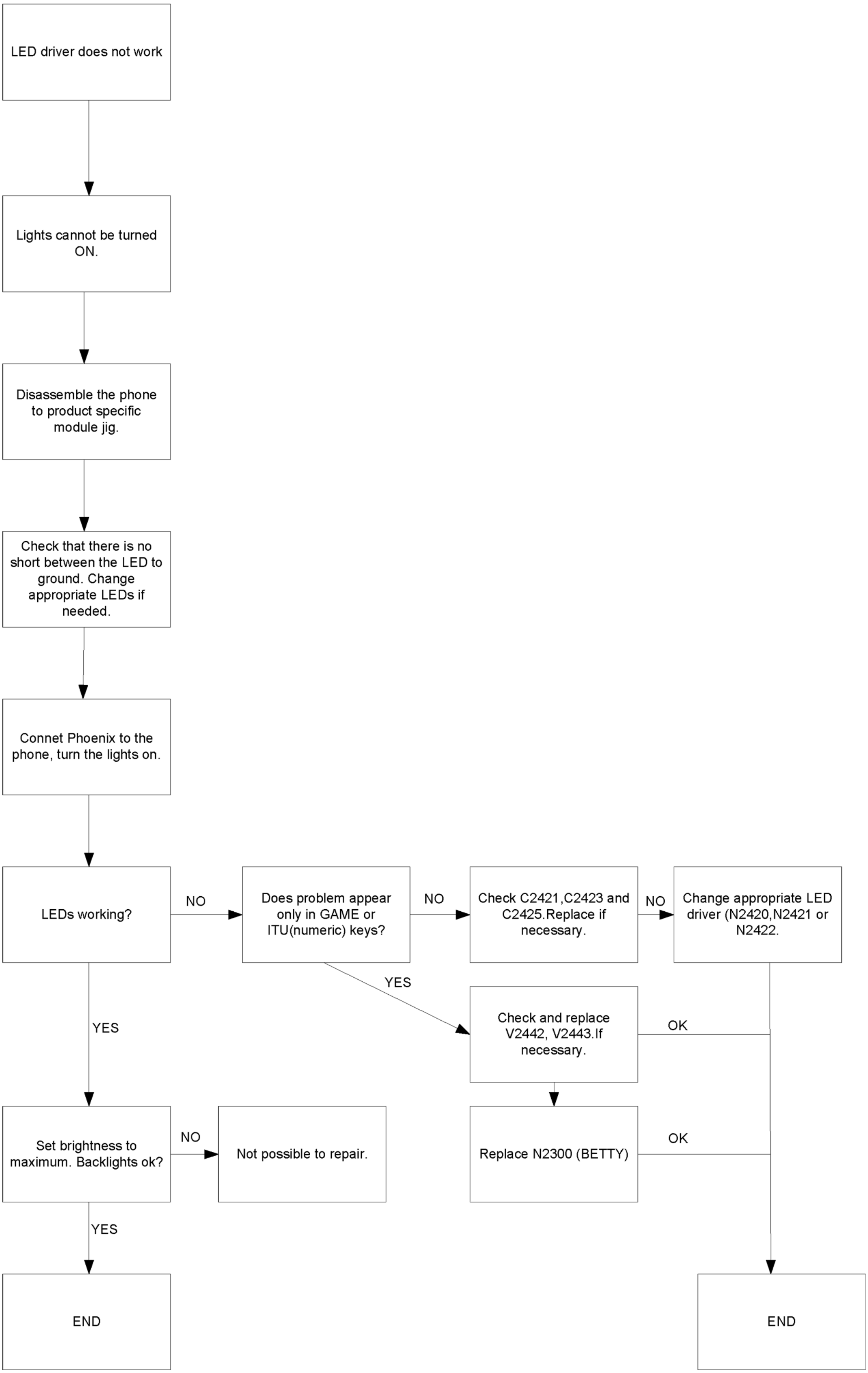

Side key or MM key backlights don't work as expected
Is the whole light segment unlit?
No
Check faulty LED and its dropping resistor
Yes
Game LEDs are failing?
Yes
Check V2443 on the engine PWB
No
Side key LEDs are failing?
Yes
Check L2422, C2424 and C2425 on the engine PWB
Replace N2422 on the engine PWB
No
Check L2421, C2422 and C2423 on the engine PWB
Replace N2421 on the engine PWB

Troubleshooting flow


ITU backlights don't work as expected
Turn ALS OFF using Phoenix
Turn ITU backlights ON and OFF using Phoenix. OK?
Yes
Go to ALS troubleshooting
No
Check ITU LEDs V2428, V2429 and resistors R2430, R2431 on the engine PWB
Check V2442, L2422, C2424 and C2425 on the engine PWB
Replace N2422 on the engine PWB

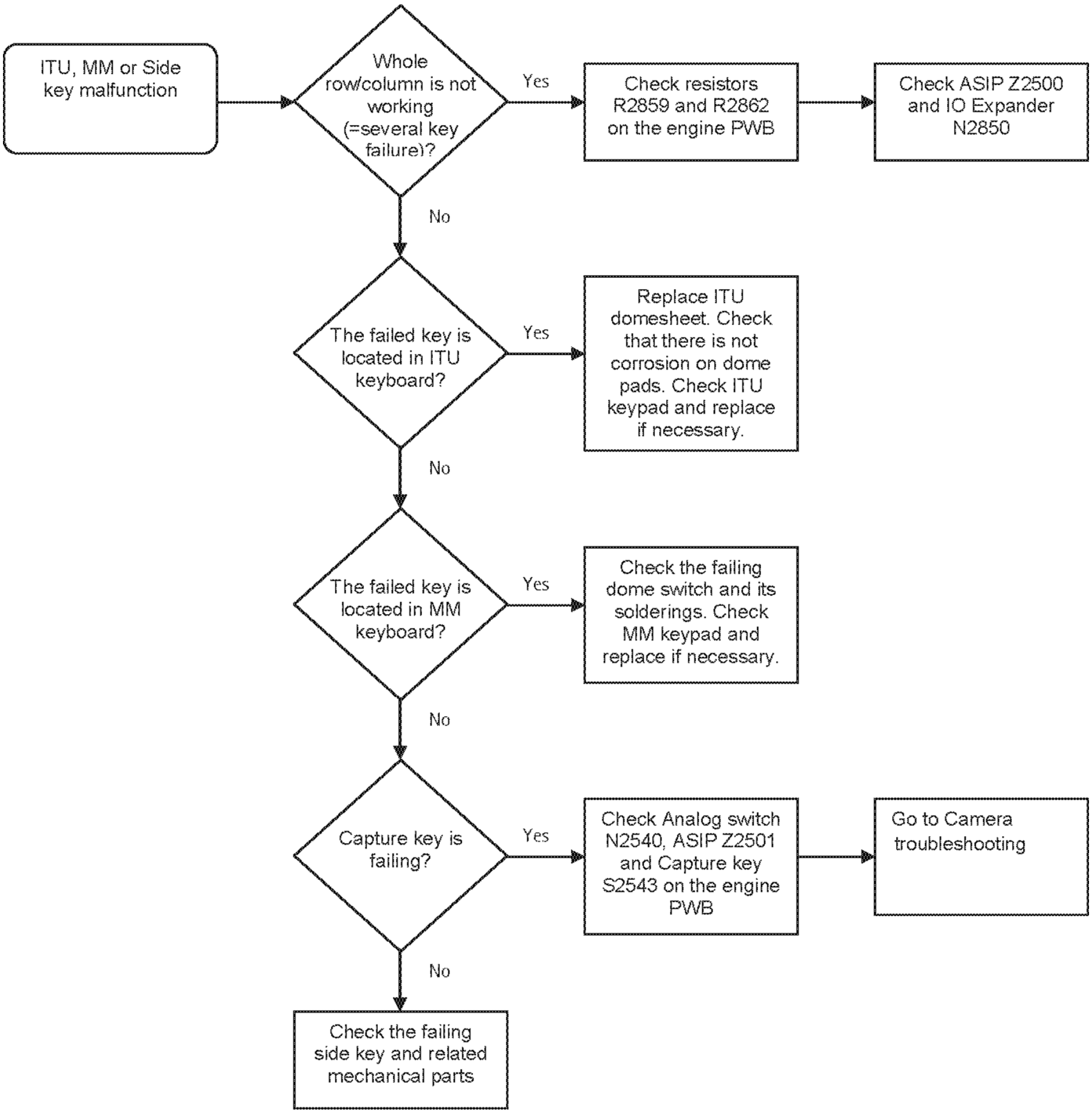
LED driver troubleshooting

Troubleshooting flow


LED driver does not work
Lights cannot be turned ON.
Disassemble the phone to product specific module jig.
Check that there is no short between the LED to ground. Change appropriate LEDs if needed.
Connet Phoenix to the phone, turn the lights on.
LEDs working?
NO
Does problem appear only in GAME or ITU(numeric) keys?
NO
Check C2421,C2423 and C2425.Replace if necessary.
NO
Change appropriate LED driver (N2420,N2421 or N2422.
YES
Check and replace V2442, V2443.If necessary.
OK
YES
Set brightness to maximum. Backlights ok?
NO
Not possible to repair.
Replace N2300 (BETTY)
OK
YES
END
END

I/O expander troubleshooting

Troubleshooting flow


ITU, MM or Side key malfunction
Whole row/column is not working (=several key failure)?
Yes
Check resistors R2859 and R2862 on the engine PWB
Check ASIP Z2500 and IO Expander N2850
No
The failed key is located in ITU keyboard?
Yes
Replace ITU domesheet. Check that there is not corrosion on dome pads. Check ITU keypad and replace if necessary.
No
The failed key is located in MM keyboard?
Yes
Check the failing dome switch and its solderings. Check MM keypad and replace if necessary.
No
Capture key is failing?
Yes
Check Analog switch N2540, ASIP Z2501 and Capture key S2543 on the engine PWB
Go to Camera troubleshooting
No
Check the failing side key and related mechanical parts

Audio Troubleshooting

Audio troubleshooting test instructions

Single-ended external earpiece and differential internal earpiece outputs can be measured either with a single-ended or a differential probe.

When measuring with a single-ended probe each output is measured against the ground.

Internal handsfree output is measured using a current probe, if a special low-pass filter designed for measuring a digital amplifier is not available. Note also that when using a current probe, the input signal frequency must be set to 2 kHz.

The input signal for each loop test can be either single-ended or differential. Exception to this is a digital microphone, which needs input signal from an external sound source (laptop speaker) to playback eg. 1kHz sine wave from 5cm distance

Required equipment

The following equipment is needed for the tests:

- Oscilloscope
- Function generator (sine waveform)
- Current probe (Internal handsfree DPMA output measurement)
- Phoenix service software
- Battery voltage 3.7V
- Sound source (laptop speaker or B&K type 4231 calibrator)

Test procedure

Audio can be tested using the Phoenix audio routings option. Three different audio loop paths can be activated:

- External microphone to Internal earpiece
- External microphone to Internal handsfree speaker
- Internal microphone to External earpiece

Each audio loop sets routing from the specified input to the specified output enabling a quick in-out test. Loop path gains are fixed and they cannot be changed using Phoenix. Correct pins and signals for each test are presented in the following table.

Phoenix audio loop tests and test results

The results presented in the table apply when no accessory is connected and battery voltage is set to 3.7V.

Earpiece, internal microphone and speaker are in place during measurement. Applying a headset accessory during measurement causes a significant drop in measured quantities.

The gain values presented in the table apply for a differential output vs. single-ended/differential input.

Loop test	Input terminal	Output terminal	Path gain [dB] (fixed)	Input voltage [mVp-p]	Outout voltage [mVp-p]	Output DC level [V]	Output current [mA]
External Mic to External Earpiece	HS_MIC & GND	HS_EAR_L & GND HS_EAR_R & GND	-8.6	1000	367	1.2	NA
External Mic to Internal Earpiece	HS_MIC & GND	EarP & GND EarN & GND	-10	1000	310	1.2	NA
External Mic to Internal handsfree	HS_MIC & GND	J2103 & J2104 J2101 & J2102	-6	1000			

Loop test	Input terminal	Output terminal	Path gain [dB] (fixed)	Input voltage [mVp-p]	Outout voltage [mVp-p]	Output DC level [V]	Output current [mA]
Digital Mic to External Earpiece	Acoustical input, 1KHz sine wave	HS_EAR_L & GND	NA	94 dB SPL	100		NA

Measurement data

Earpiece signal

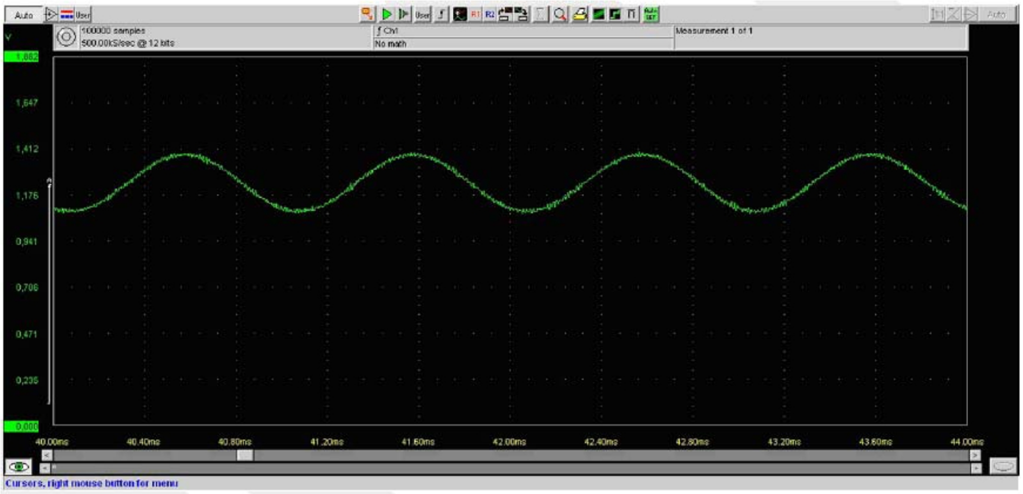

100000 samples
500.00kS/sec @ 12 bits
Ch1
No math
Measurement 1 of 1
Cursors, right mouse button for menu
Auto
User
V
1,882
1,647
1,412
1,176
0,941
0,706
0,471
0,235
0,000
40.00ms
40.40ms
40.80ms
41.20ms
41.60ms
42.00ms
42.40ms
42.80ms
43.20ms
43.60ms
44.00ms

Figure 14 Single-ended output waveform of the Ext_in_HP_out measurement when earpiece is connected

Integrated handsfree signal

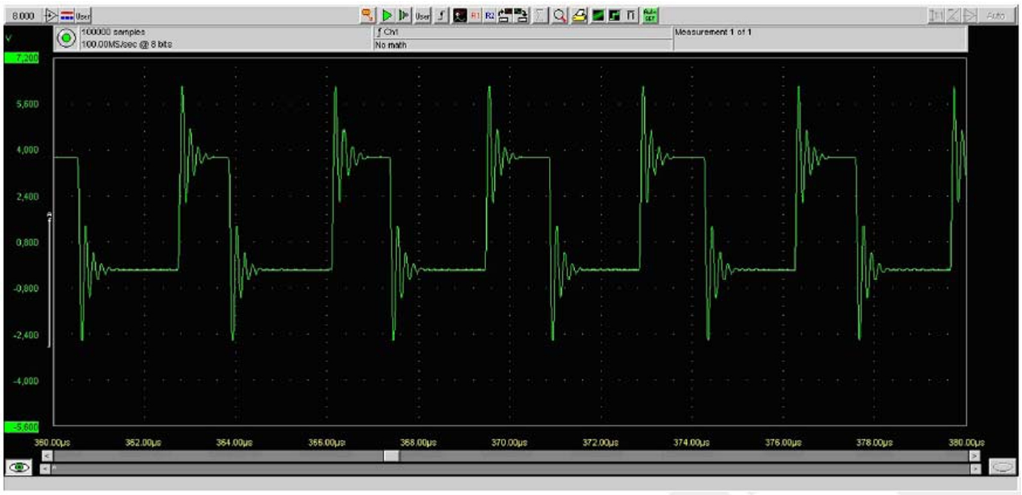
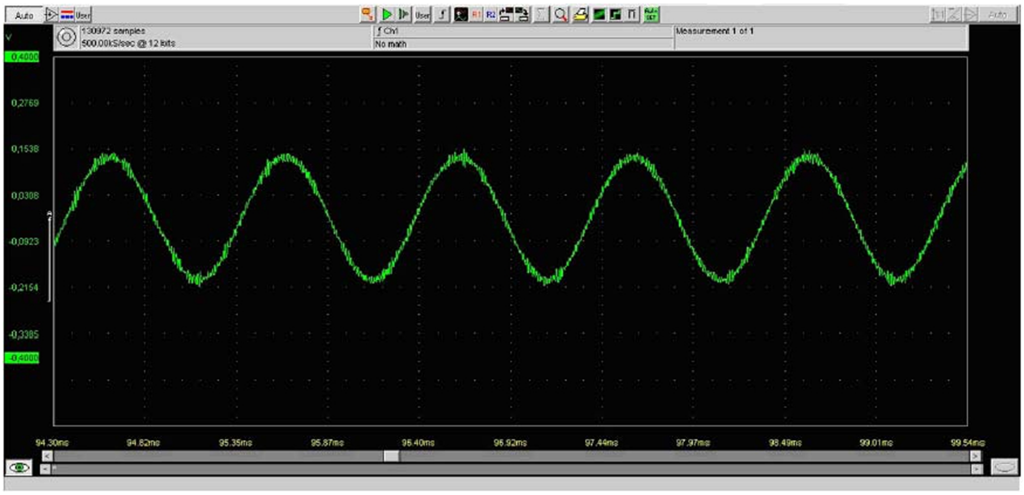

100000 samples
100.00MS/sec @ 8 bits
Ch1
No math
Measurement 1 of 1
8.000
User
V
7,200
5,600
4,000
2,400
0,800
-0,800
-2,400
-4,000
-5,600
360.00µs
362.00µs
364.00µs
366.00µs
368.00µs
370.00µs
372.00µs
374.00µs
376.00µs
378.00µs
380.00µs

Figure 15 Single-ended output waveform of the Ext_in_IHF_out out loop measurement when speaker is connected (measured at speaker pads), no filter is used

External output from AV

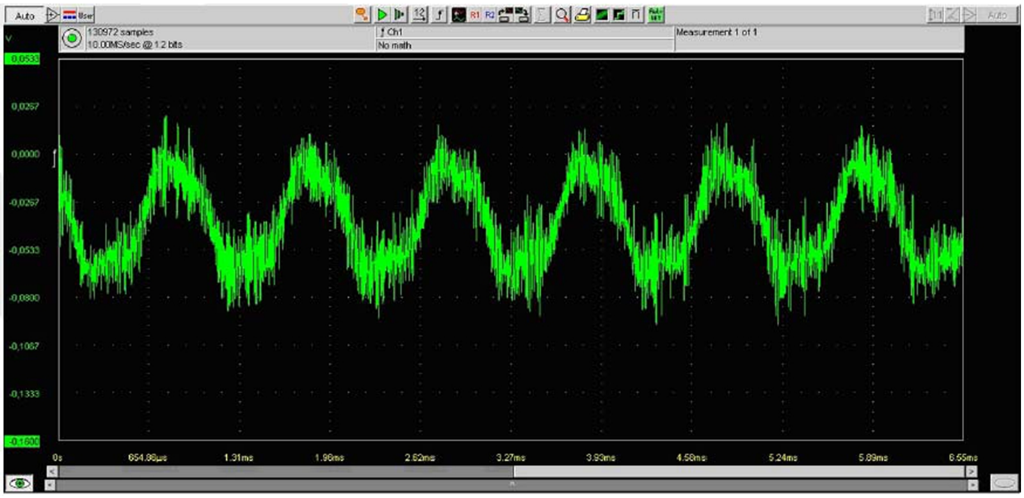


130972 samples
500,00kS/sec @ 12 bits
Ch1
No math
Measurement 1 of 1

Auto
User
V
0,4000
0,2769
0,1538
0,0308
-0,0923
-0,2154
-0,3385
-0,4000
94.30ms
94.82ms
95.35ms
95.87ms
96.40ms
96.92ms
97.44ms
97.97ms
98.49ms
99.01ms
99.54ms

Figure 16 Single-ended output waveform of the Ext_in_Ext_out loop

External output from AV (acoustic input)



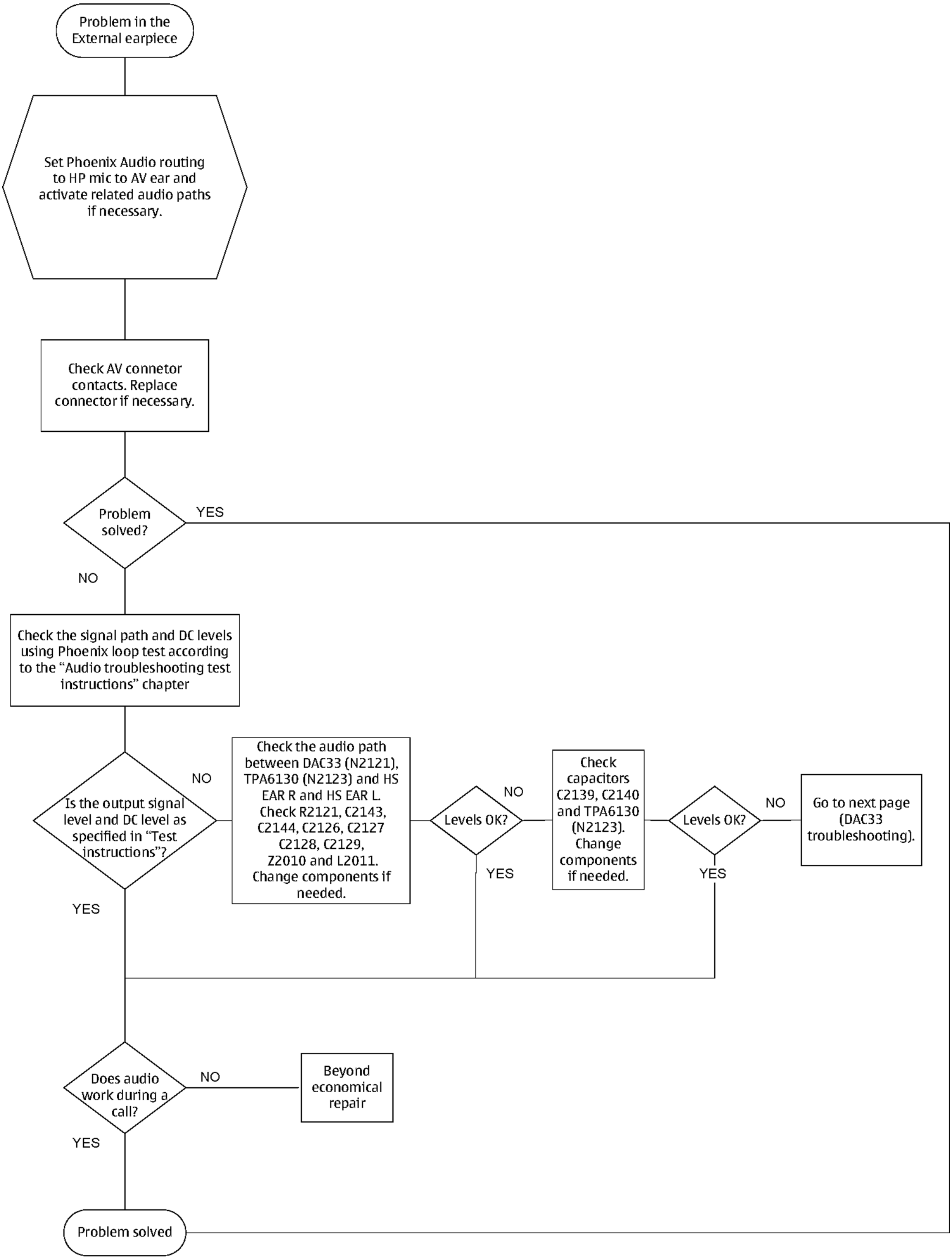
130972 samples
10.00MS/sec @ 12 bits
Ch1
No math
Measurement 1 of 1

Auto
User
V
0,0533
0,0267
0,0000
-0,0267
-0,0533
-0,0800
-0,1067
-0,1333
-0,1600
0s
654.86µs
1.31ms
1.96ms
2.62ms
3.27ms
3.93ms
4.58ms
5.24ms
5.89ms
6.55ms

Figure 17 Single-ended output waveform of the Digital_stereo_microphone_in_Ext_out loop

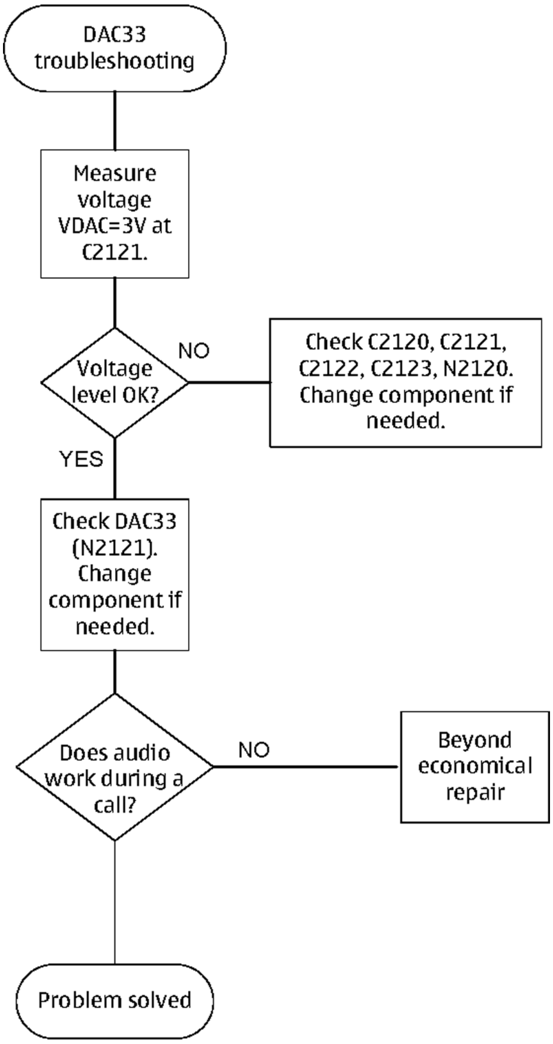
External earpiece troubleshooting

Troubleshooting flow


Problem in the External earpiece
Set Phoenix Audio routing to HP mic to AV ear and activate related audio paths if necessary.
Check AV connetor contacts. Replace connector if necessary.
Problem solved?
YES
NO
Check the signal path and DC levels using Phoenix loop test according to the "Audio troubleshooting test instructions" chapter
Is the output signal level and DC level as specified in "Test instructions"?
NO
YES
Check the audio path between DAC33 (N2121), TPA6130 (N2123) and HS EAR R and HS EAR L. Check R2121, C2143, C2144, C2126, C2127 C2128, C2129, Z2010 and L2011. Change components if needed.
Levels OK?
NO
YES
Check capacitors C2139, C2140 and TPA6130 (N2123). Change components if needed.
Levels OK?
NO
YES
Go to next page (DAC33 troubleshooting).
Does audio work during a call?
NO
YES
Beyond economical repair
Problem solved

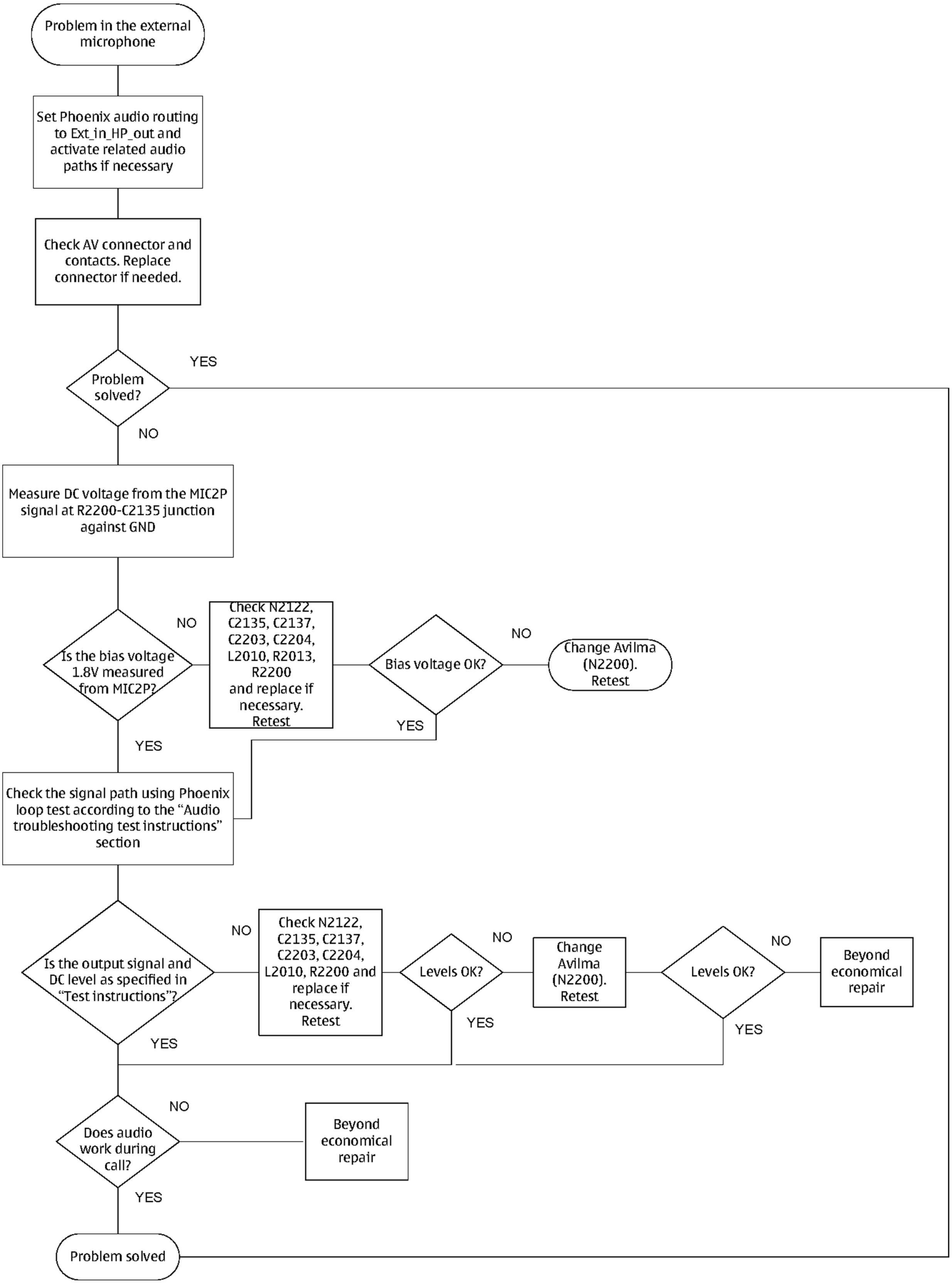
DAC33 troubleshooting

Troubleshooting flow


DAC33 troubleshooting
Measure voltage VDAC=3V at C2121.
Voltage level OK?
NO
Check C2120, C2121, C2122, C2123, N2120. Change component if needed.
YES
Check DAC33 (N2121). Change component if needed.
Does audio work during a call?
NO
Beyond economical repair
Problem solved

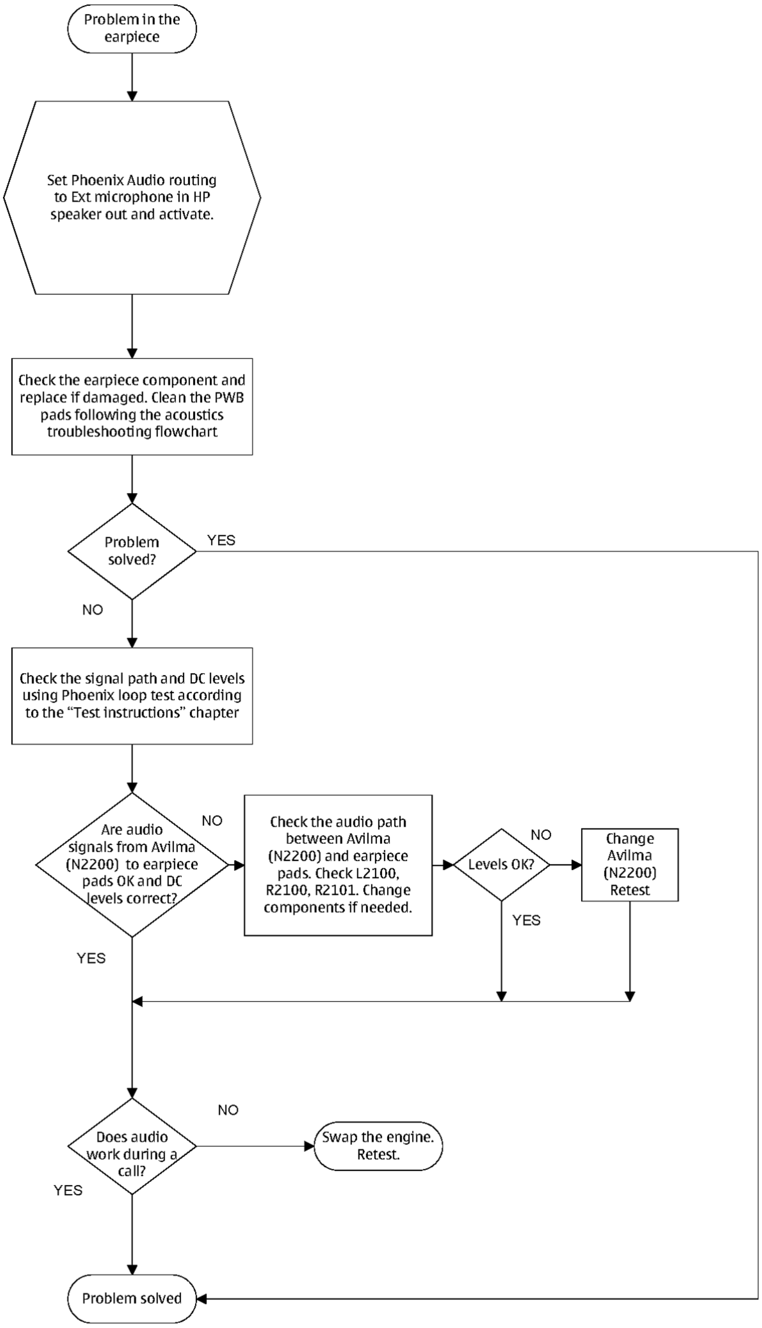
External microphone troubleshooting

Troubleshooting flow


Problem in the external microphone
Set Phoenix audio routing to Ext_in_HP_out and activate related audio paths if necessary
Check AV connector and contacts. Replace connector if needed.
Problem solved?
YES
NO
Measure DC voltage from the MIC2P signal at R2200-C2135 junction against GND
Is the bias voltage 1.8V measured from MIC2P?
NO
Check N2122, C2135, C2137, C2203, C2204, L2010, R2013, R2200 and replace if necessary. Retest
Bias voltage OK?
NO
Change Avilma (N2200). Retest
YES
YES
Check the signal path using Phoenix loop test according to the "Audio troubleshooting test instructions" section
Is the output signal and DC level as specified in "Test instructions"?
NO
Check N2122, C2135, C2137, C2203, C2204, L2010, R2200 and replace if necessary. Retest
Levels OK?
NO
Change Avilma (N2200). Retest
Levels OK?
NO
Beyond economical repair
YES
YES
YES
Does audio work during call?
NO
Beyond economical repair
YES
Problem solved

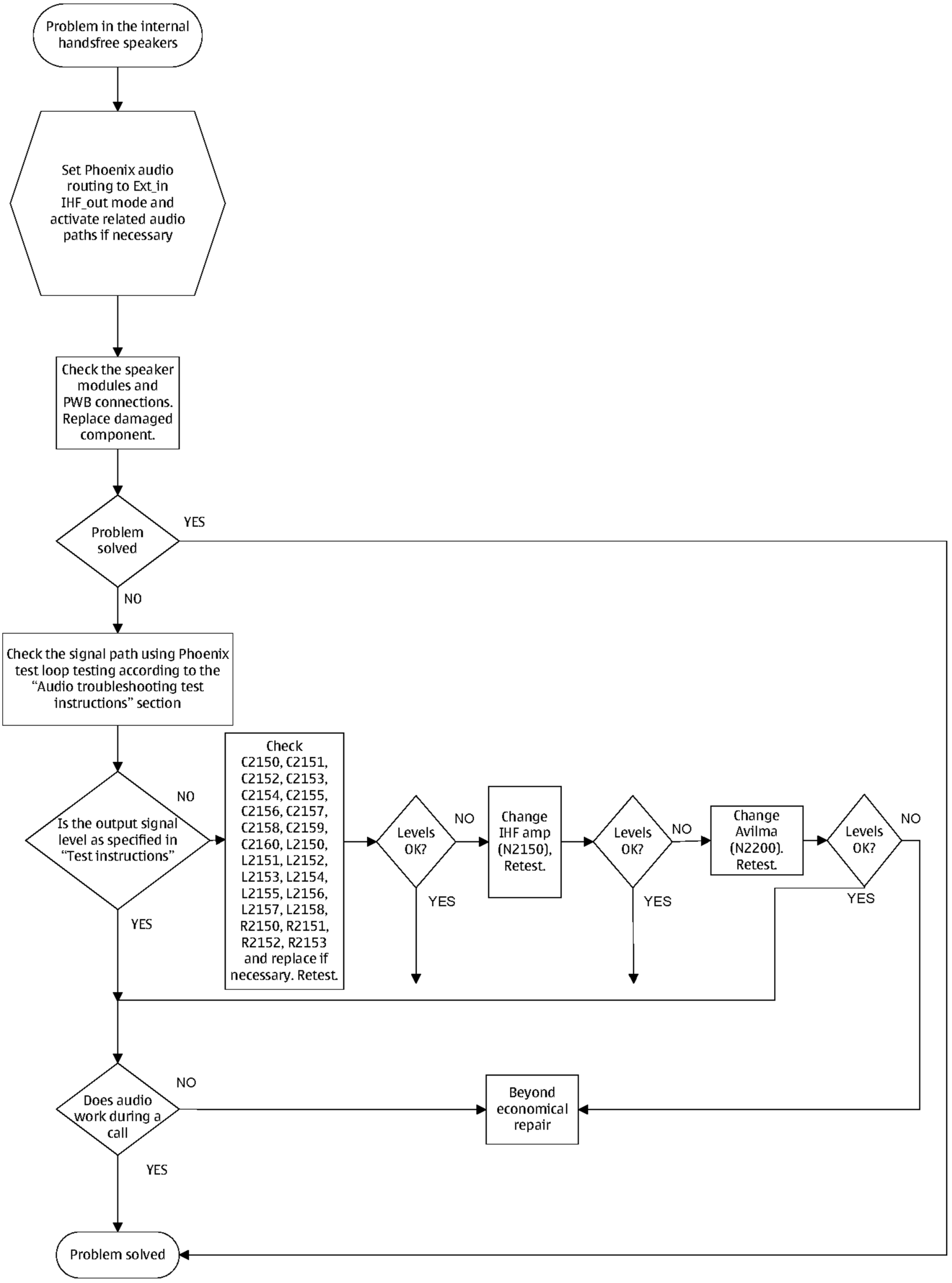
Internal earpiece troubleshooting

Troubleshooting flow


Problem in the earpiece
Set Phoenix Audio routing to Ext microphone in HP speaker out and activate.
Check the earpiece component and replace if damaged. Clean the PWB pads following the acoustics troubleshooting flowchart
Problem solved?
YES
NO
Check the signal path and DC levels using Phoenix loop test according to the "Test instructions" chapter
Are audio signals from Avilma (N2200) to earpiece pads OK and DC levels correct?
NO
Check the audio path between Avilma (N2200) and earpiece pads. Check L2100, R2100, R2101. Change components if needed.
Levels OK?
NO
Change Avilma (N2200) Retest
YES
YES
Does audio work during a call?
NO
Swap the engine. Retest.
YES
Problem solved

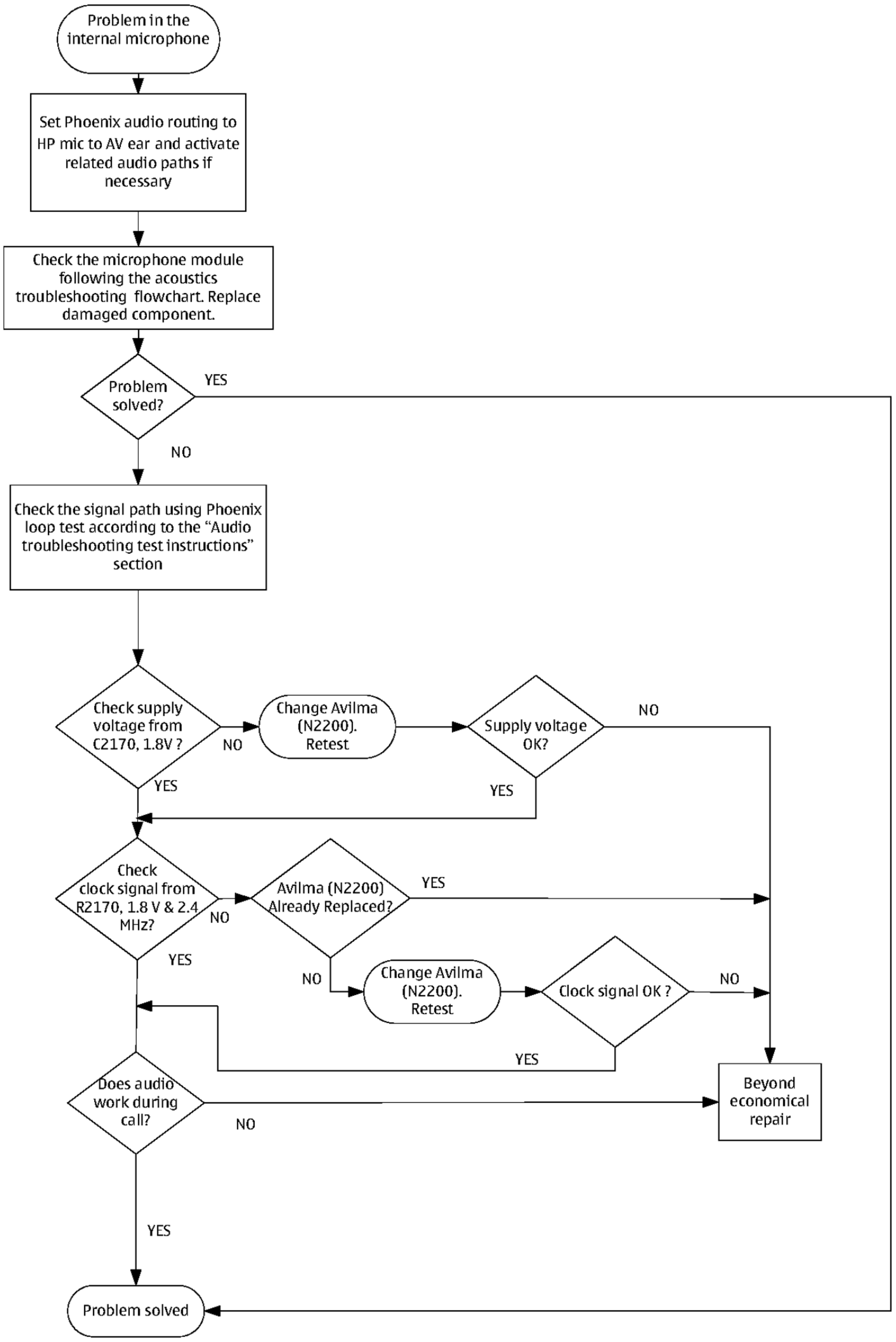
Internal handsfree speaker troubleshooting

Troubleshooting flow


Problem in the internal handsfree speakers
Set Phoenix audio routing to Ext_in IHF_out mode and activate related audio paths if necessary
Check the speaker modules and PWB connections. Replace damaged component.
Problem solved
YES
NO
Check the signal path using Phoenix test loop testing according to the "Audio troubleshooting test instructions" section
Is the output signal level as specified in "Test instructions"
NO
YES
Check C2150, C2151, C2152, C2153, C2154, C2155, C2156, C2157, C2158, C2159, C2160, L2150, L2151, L2152, L2153, L2154, L2155, L2156, L2157, L2158, R2150, R2151, R2152, R2153 and replace if necessary. Retest.
Levels OK?
NO
YES
Change IHF amp (N2150), Retest.
Levels OK?
NO
YES
Change Avilma (N2200). Retest.
Levels OK?
NO
YES
Does audio work during a call
NO
YES
Beyond economical repair
Problem solved

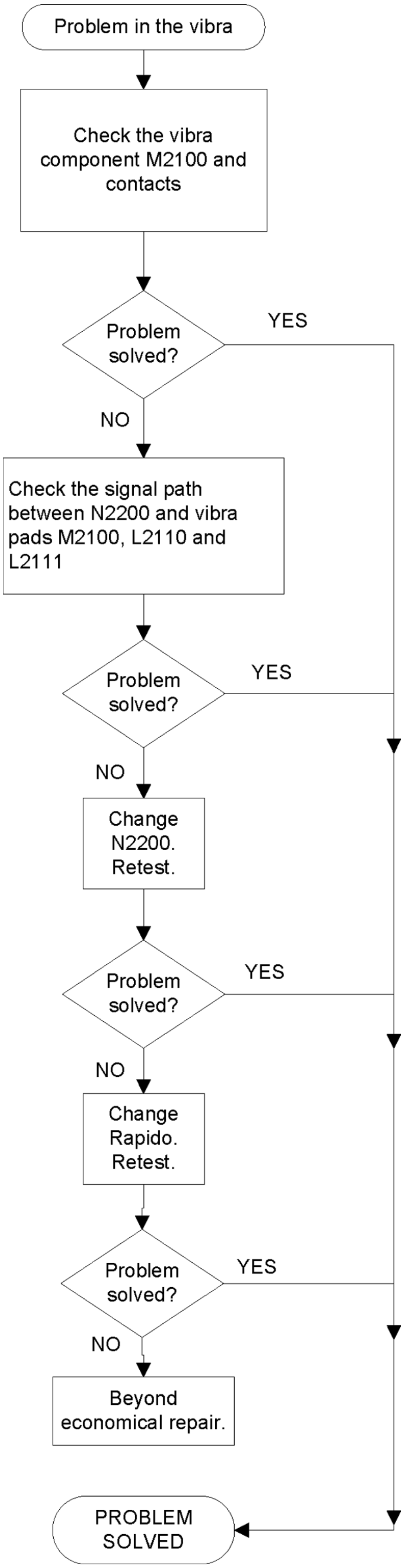
Internal microphone troubleshooting

Troubleshooting flow


Problem in the internal microphone
Set Phoenix audio routing to HP mic to AV ear and activate related audio paths if necessary
Check the microphone module following the acoustics troubleshooting flowchart. Replace damaged component.
Problem solved?
YES
NO
Check the signal path using Phoenix loop test according to the "Audio troubleshooting test instructions" section
Check supply voltage from C2170, 1.8V ?
NO
Change Avilma (N2200). Retest
Supply voltage OK?
NO
YES
YES
Check clock signal from R2170, 1.8 V & 2.4 MHz?
NO
Avilma (N2200) Already Replaced?
YES
YES
NO
Change Avilma (N2200). Retest
Clock signal OK ?
NO
YES
Does audio work during call?
NO
Beyond economical repair
YES
Problem solved

Vibra troubleshooting

Troubleshooting flow


Problem in the vibra
Check the vibra component M2100 and contacts
Problem solved?
YES
NO
Check the signal path between N2200 and vibra pads M2100, L2110 and L2111
Problem solved?
YES
NO
Change N2200. Retest.
Problem solved?
YES
NO
Change Rapido. Retest.
Problem solved?
YES
NO
Beyond economical repair.
PROBLEM SOLVED

ALS Technical Description and Troubleshooting

Ambient Light Sensor

Ambient Light Sensor

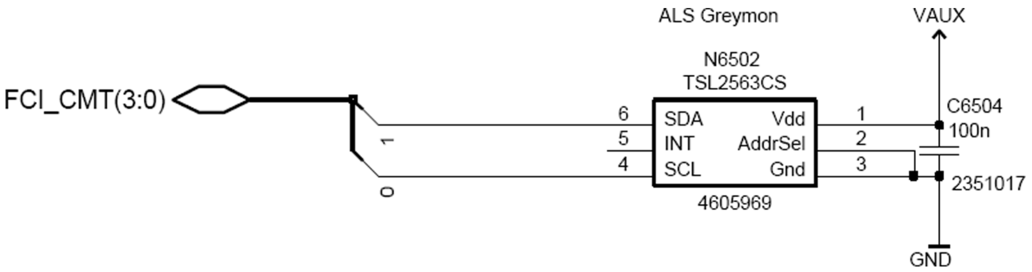


Figure 18 Ambient Light Sensor

Ambient Light Sensor consists of the following components:

- Light guide
- Ambient Light Sensor (ALS)

  ALS is a digital I2C interface component, having two channels with different spectral sensitivities. When combined, the component responds to illuminance similar as human eye.
- Vdd Filtering capacitor C1103

Ambient Light Sensor information is used to control keypad and display brightness of the phone.

Keyboard backlight is turned OFF, when it's not needed. Display brightness is dimmed, when environment lighting is dark.

Ambient Light Sensor is calibrated in production and can be re-tuned in service points though not recommended unless calibration coefficient are lost for some reason

ALS troubleshooting

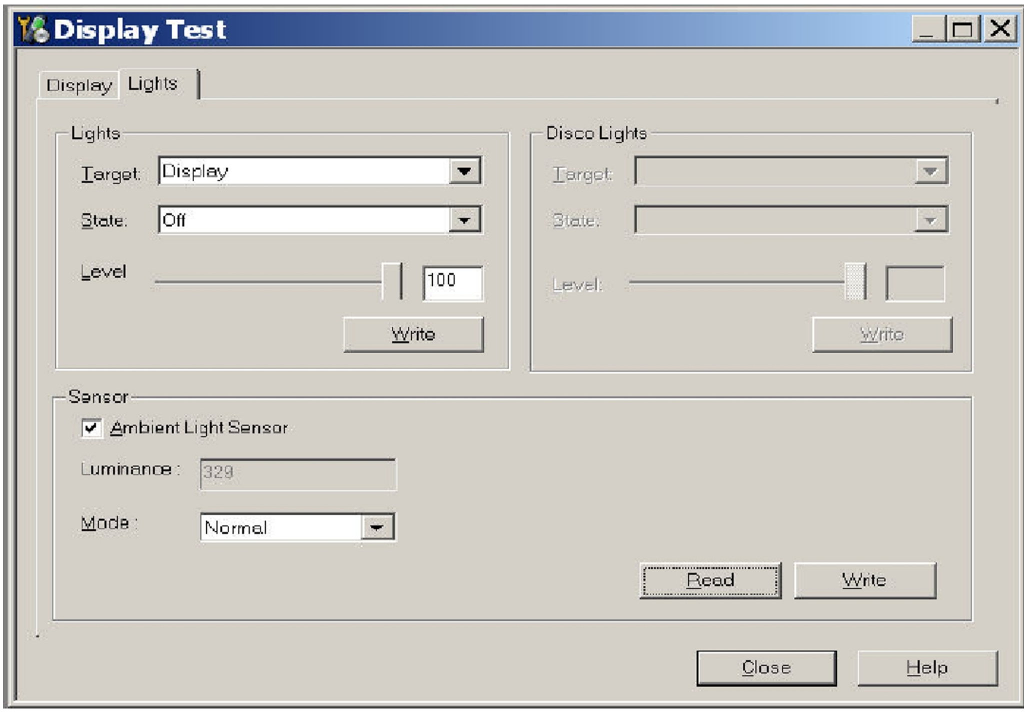
Context

Functionality check:

Steps

1. Connect phone to Phoenix and set the phone (e.g. on the table) so that the amount of ambient light seen by ALS is as stable as possible.
2. Start Phoenix
3. Choose **File -> Scan product**
4. Choose **Testing -> Display Test**
5. Open the **Lights** tab, check Ambient Light Sensor check box, click **Read**, cover the sensor and click **Read** again. When covered, Luminance reading should be less than after clicking **Read** without covering the sensor.

6. If component doesn’t give any reading or reading doesn’t change when sensor is/is not covered, replace the part.


Display Test
Display
Lights
Lights
Disco Lights
Target:
State:
Level:
Write
Sensor
Read
Write
Close
Help

Target: Display
State: Off
Level 100
☑ Ambient Light Sensor
Luminance : 329
Mode : Normal

Note: After replacing the ALS. If calibration values of the new sensor are lost or for some other reason, ALS re-tuning is required (see instructions later in this document).

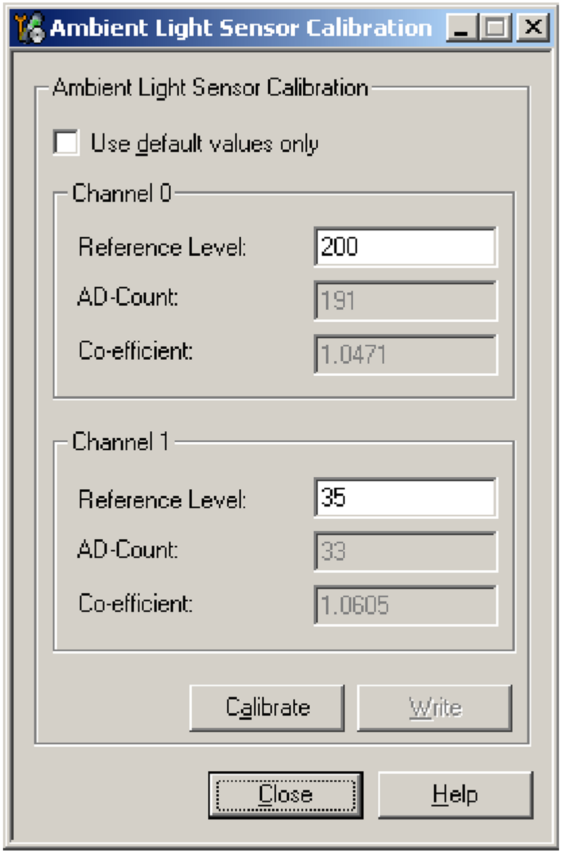
When doing the ALS calibration procedure, it is required to have a reference phone, which includes calibrated ALS. ALS re-tuning instructions show why the reference phone is needed.

Re-tuning ALS

Steps

1. Connect reference phone to Phoenix and set the phone (e.g. on the table) so that the amount of ambient light seen by ALS is as stable as possible.
2. Start Phoenix.
3. Choose **File→Scan Product.**

4. Choose **Tuning -> Ambient Light Sensor Calibration**. You should see the following window:



Ambient Light Sensor Calibration
Ambient Light Sensor Calibration
Calibrate
Write
Close
Help

☐ Use default values only

Channel 0

Reference Level: 200
AD-Count: 191
Co-efficient: 1.0471

Channel 1

Reference Level: 35
AD-Count: 33
Co-efficient: 1.0605

5. Read AD-count values for Channel 0 and Channel 1 by click **Read** button and write them down.
6. Repeat 1-5 for the phone to be calibrated and make sure the phone to be calibrated is located in the same place as reference phone was when luminance reading was taken.
7. Calculate co-efficient from reference phone and phone to be calibrated AD-count values by division: Co-efficient = AD-count(reference phone) / AD-count(phone to be calibrated), write down the calculated co-efficient values.
8. -> Iterate by changing Channel 0 and Channel 1 (reference level) values (remove cross from ‘Use default values only’). After writing some value to Channel 0 and Channel 1 (reference value), calibrate button must be pressed. Stop iterating when Co-efficient is equal to Co-efficient calculated in step 7. Note that decimal numbers should be used in the iteration in order to achieve enough precision (e.g. 200.2455)
9. After having same Co-efficient value in “Co-efficient” textbox as the calculated value, make sure that ambient light values (read using **Testing** → **Display Test** → **“Luminance”** textbox) are almost the same in reference phone and calibrated phone. Remember that illuminance readings for reference and calibrated phones must be done in the same ambient light conditions. If illuminance values differs a lot (difference max. +- 10%), repeat whole ALS re-tuning procedure.
10. To end the calibration, click Close.

Bluetooth and FM Radio Troubleshooting

Introduction to Bluetooth/FM radio troubleshooting

Bluetooth/WLAN antenna

The BT RF signal is routed from BTFMRDS2.1 through the WLAN module to the shared WLAN/BT antenna in the phone's C-cover.

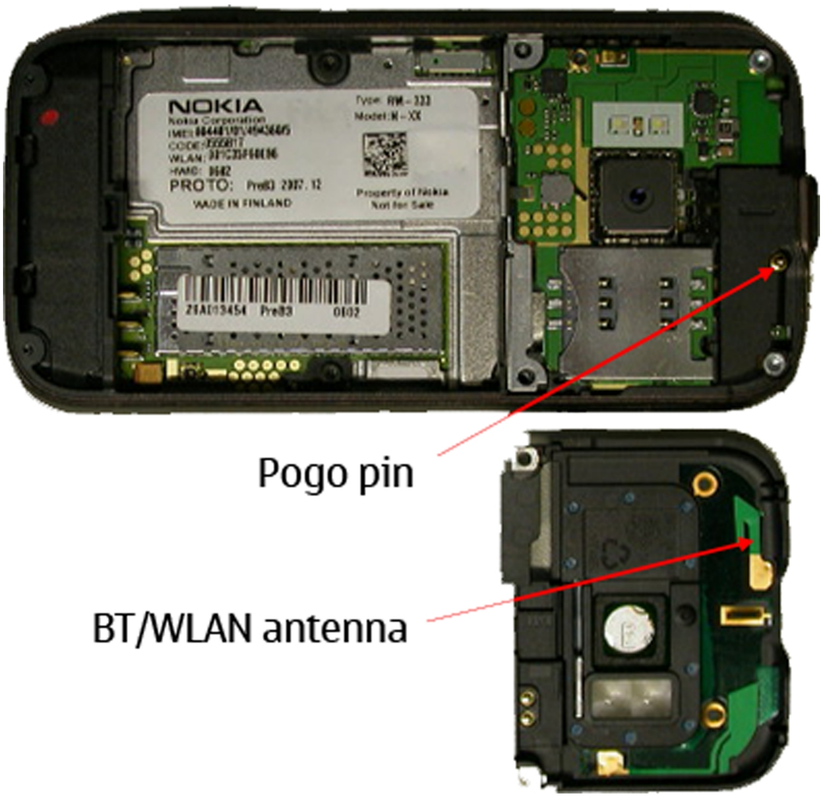


Figure 19 Bluetooth/WLAN antenna

Introduction to Bluetooth/FM radio troubleshooting

The Bluetooth and FM radio are combined in the same ASIC, so both features are checked when troubleshooting.

The following problems can occur with the Bluetooth and FM radio hardware:

Symptom	Problem	Repair solution
Unable to switch on Bluetooth on phone user interface	Open circuit solder joints or component failure of BTH/FM ASIC/module BB ASICs or SMD components.	Replacement of Bluetooth/ FM ASIC/module
Able to send data file to another Bluetooth device, but unable to hear audio through functional Bluetooth headset	Open circuit solder joints or component failure of BTH/FM ASIC/module BB ASICs.	Replacement of Bluetooth/ FM ASIC/module
Able to switch on Bluetooth on phone user interface, but unable to detect other Bluetooth devices	Open circuit solder joints or Pogo Pins not making contact with c-cover	Repair or replace c-cover
Able to turn on FM radio and Bluetooth on phone user interface, but unable to detect local FM radio stations with Nokia headset inserted	Open circuit solder joints or detached component in FM antenna circuit	Repair of FM antenna connection or FM circuit component

Symptom	Problem	Repair solution
Able to perform scans to detect local FM radio stations with functional Nokia headset inserted, but unable to hear FM audio through headset	Open circuit solder joints or detached component in FM audio path between Bluetooth/ FM ASIC and headset	Repair of FM audio circuit

Users may experience the following problems resulting in functional phones being returned to the repair centre:

Symptom	Problem	Repair solution
Bluetooth feature does not operate as desired with another Bluetooth device	Bluetooth Profile implemented in Bluetooth accessory not supported in Nokia phone	Use Bluetooth accessory with Bluetooth profiles supported by phone
Poor FM radio reception (unable to detect many radio stations)	Nokia headset not being used	Use Nokia headset

Test coverage

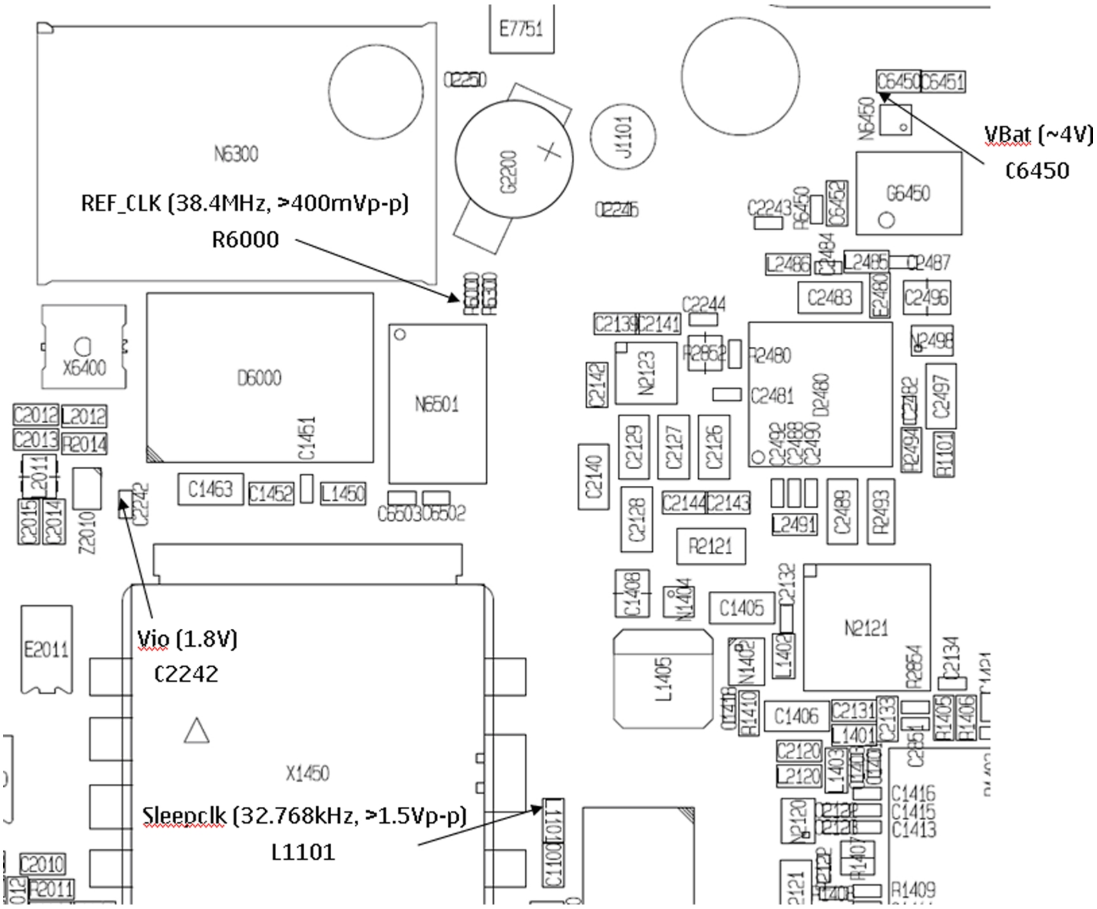
The tests listed in the table below should be performed to verify whether the Bluetooth and FM receiver and transmitter are functional. The use of Self Tests are described in section *BT and FM Self Tests in Phoenix*

Test	Test Coverage	Repair solution
Blueooth Self Test: ST_LPRF_IF_TEST	Bluetooth-FM ASIC UART interface (controls Bluetooth and FM receiver and transmitter)	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
Bluetooth Self Test: ST_BT_WAKEUP_TEST	Bluetooth ASIC interrupt control interface	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
Bluetooth Self Test: ST_LPRF_AUDIO_LINES_TEST	Bluetooth ASIC PCM interface	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
Bluetooth Functional Test: BER test with BT-Box or functional test with other Bluetooth device	Bluetooth antenna circuit	Repair of Bluetooth antenna circuit (including RF filter or WLAN switch if fitted)
FM Radio Self Test: ST_RADIO_TEST	FM Radio I2C interface	Replacement of Bluetooth/FM ASIC (or repair of phone BB)
FM Radio Functional Test: Perform scan for local radio stations and check station list displayed on phone	FM receiver antenna circuit	Repair of FM antenna circuit (between BTHFM ASIC and headset connector)
FM Radio Functional Test: Listen to local radio station	FM receiver audio circuit	Repair of FM receiver audio circuit (between BTHFM ASIC and headset connector)

The self tests run from Phoenix software are used for fault diagnosis.

If Phoenix software is not available the functional tests with phone accessories are sufficient to verify the functionality Bluetooth and FM radio receiver and transmitter.

Bluetooth/FM radio component layout and test points


REF_CLK (38.4MHz, >400mVp-p)
R6000

VBat (~4V)
C6450

Vio (1.8V)
C2242

Sleepclk (32.768kHz, >1.5Vp-p)
L1101

E7751
N6300
C2250
G2200
J1101
C2245
N6450
C6450
C6451
G6450
C2243
R6450
C6452
L2486
L2484
L2485
C2487
C2483
E2480
C2496
C2244
C2139
C2141
R2852
R2480
R2498
X6400
D6000
N6501
C1451
C2142
N2123
C2481
D2480
C2482
C2497
C2012
L2012
C2013
R2014
C2011
C2015
C2014
Z2010
C2242
C1463
C1452
L1450
C6503
C6502
C2140
C2129
C2127
C2126
C2492
C2488
C2490
R2494
R1101
C2128
C2144
C2143
L2491
C2489
R2493
R2121
C1408
N1404
C1405
C2132
N2121
E2011
L1405
N1402
L1402
R2854
C2134
X1450
C1406
C2131
L1401
C2133
C2135
R1405
R1406
C2120
L2120
L1403
C1416
C1415
C1413
N2120
L1101
C1100
C2010
R2011
R1409

Figure 20 BT/FM component layout

The Bluetooth antenna is product specific (antenna integrated into phone C cover). On phones with WLAN, the Bluetooth RF signal is routed through a WLAN front-end module and a shared Bluetooth / WLAN antenna is used. The FM RF signal is routed through a product specific FM antenna matching circuit to the phone headset connector. The FM radio audio signal is routed to the headset connector through the BB ASIC shared by the phone audio functions.

Bluetooth BER test

Prerequisites

JBT-9, or SB-6 Bluetooth test box (BT-box) is required to perform a BER test. If a BT-box not available Bluetooth functionality can be checked by transferring a file to another Bluetooth phone. For the BER or file transfer test the C-cover should be fitted as the BT antenna is on the C-cover.

Steps

1. Connect data cable to phone.
2. Start *Phoenix* service software.
3. Choose **File** → **Scan Product**.
4. Choose **Testing** → **Bluetooth LOCALS** .
5. Locate the BT-box serial number (12 digits) found in the type label on the back of the JBT-9, or SB-6 Bluetooth test box.

6. In the Bluetooth *LOCALS* window, write the 12-digit serial number on the *Counterpart BT Device Address* line.
7. Place the BT-box near (within 10 cm) of the phone and click **Start BER Test**.

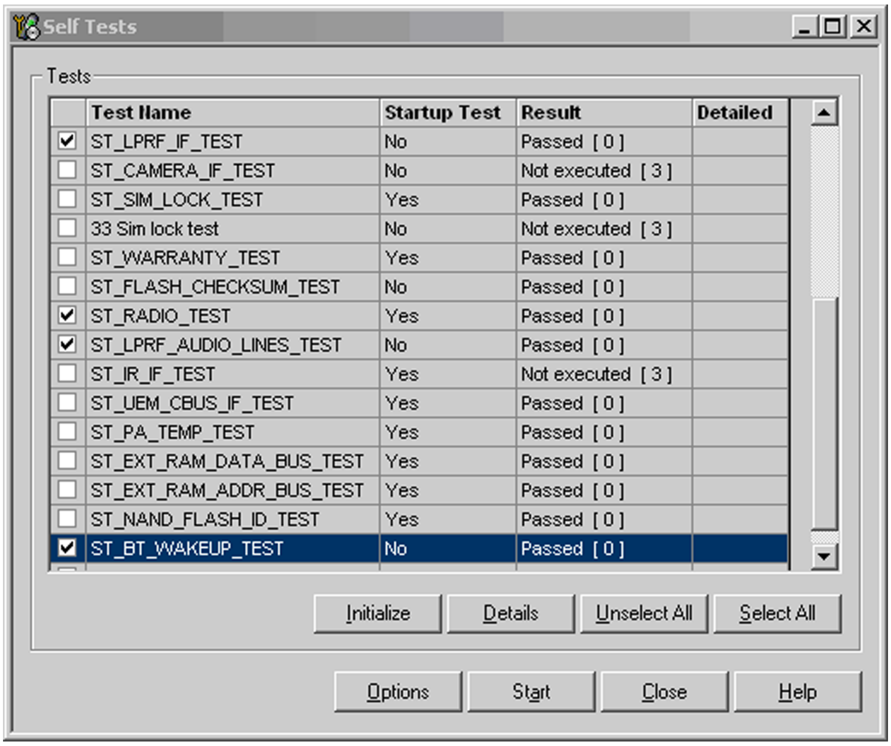
Bluetooth and FM radio self tests in Phoenix

Prerequisites

A flash adapter (or phone data cable) connected to a PC with Phoenix service software is required.

Steps

1. Place the phone in the flash adapter or connect data cable to phone.
2. Start *Phoenix* service software.
3. Choose **File→Scan Product.**
4. From the **Mode** drop-down menu, set mode to **Local**.
5. Choose **Testing→Self Tests.**
6. In the *Self Tests* window check the following Bluetooth and FM radio related tests:
   - **ST_LPRF_IF_TEST**
   - **ST_LPRF_AUDIO_LINES_TEST**
   - **ST_BT_WAKEUP_TEST**
   - **ST_RADIO_TEST**
7. To run the tests, click **Start**.

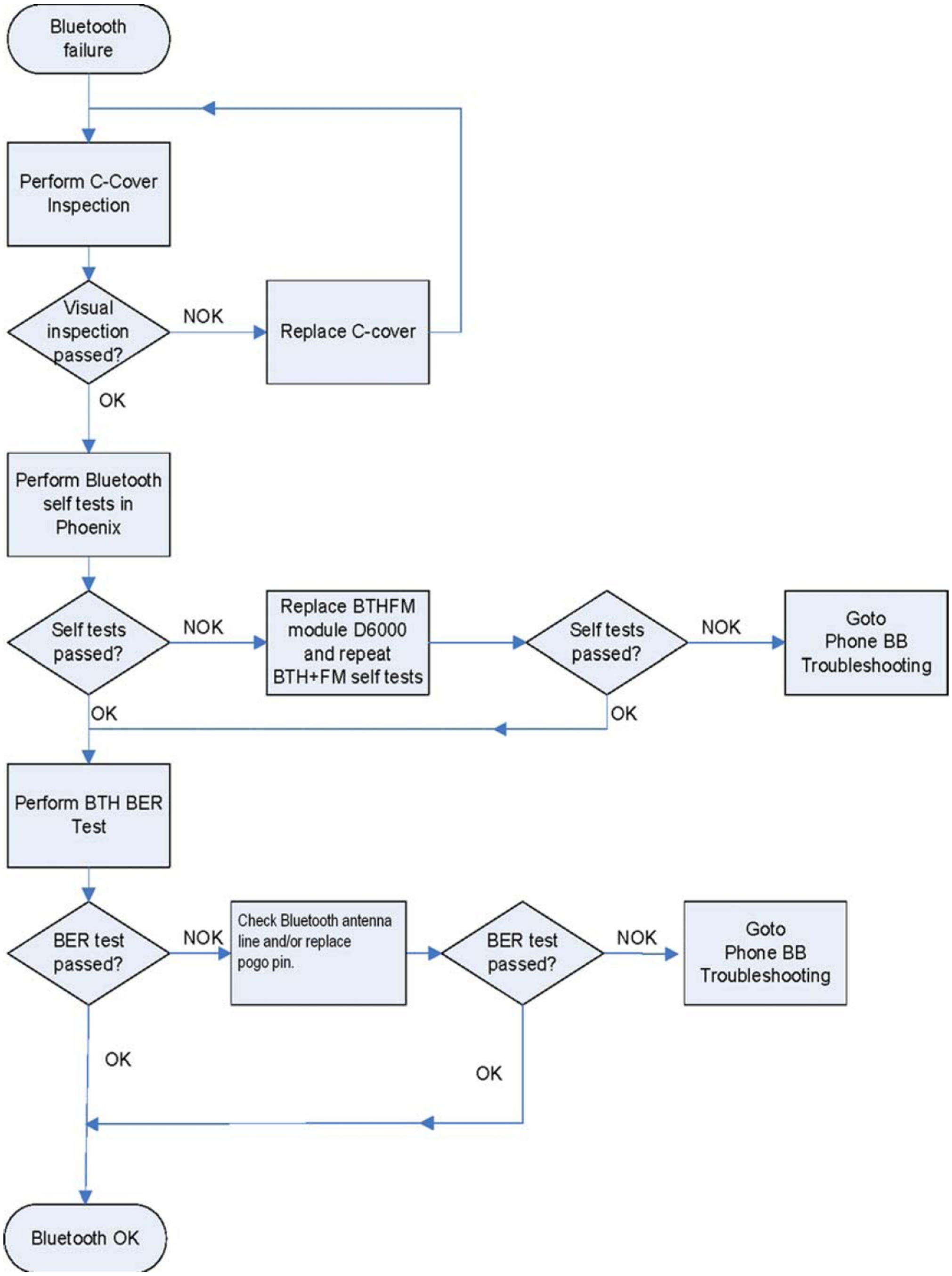


	Test Name	Startup Test	Result	Detailed
☑	ST_LPRF_IF_TEST	No	Passed [0]	
☐	ST_CAMERA_IF_TEST	No	Not executed [3]	
☐	ST_SIM_LOCK_TEST	Yes	Passed [0]	
☐	33 Sim lock test	No	Not executed [3]	
☐	ST_WARRANTY_TEST	Yes	Passed [0]	
☐	ST_FLASH_CHECKSUM_TEST	No	Passed [0]	
☑	ST_RADIO_TEST	Yes	Passed [0]	
☑	ST_LPRF_AUDIO_LINES_TEST	No	Passed [0]	
☐	ST_IR_IF_TEST	Yes	Not executed [3]	
☐	ST_UEM_CBUS_IF_TEST	Yes	Passed [0]	
☐	ST_PA_TEMP_TEST	Yes	Passed [0]	
☐	ST_EXT_RAM_DATA_BUS_TEST	Yes	Passed [0]	
☐	ST_EXT_RAM_ADDR_BUS_TEST	Yes	Passed [0]	
☐	ST_NAND_FLASH_ID_TEST	Yes	Passed [0]	
☑	ST_BT_WAKEUP_TEST	No	Passed [0]	

Figure 21 Bluetooth and FM radio self tests in *Phoenix*

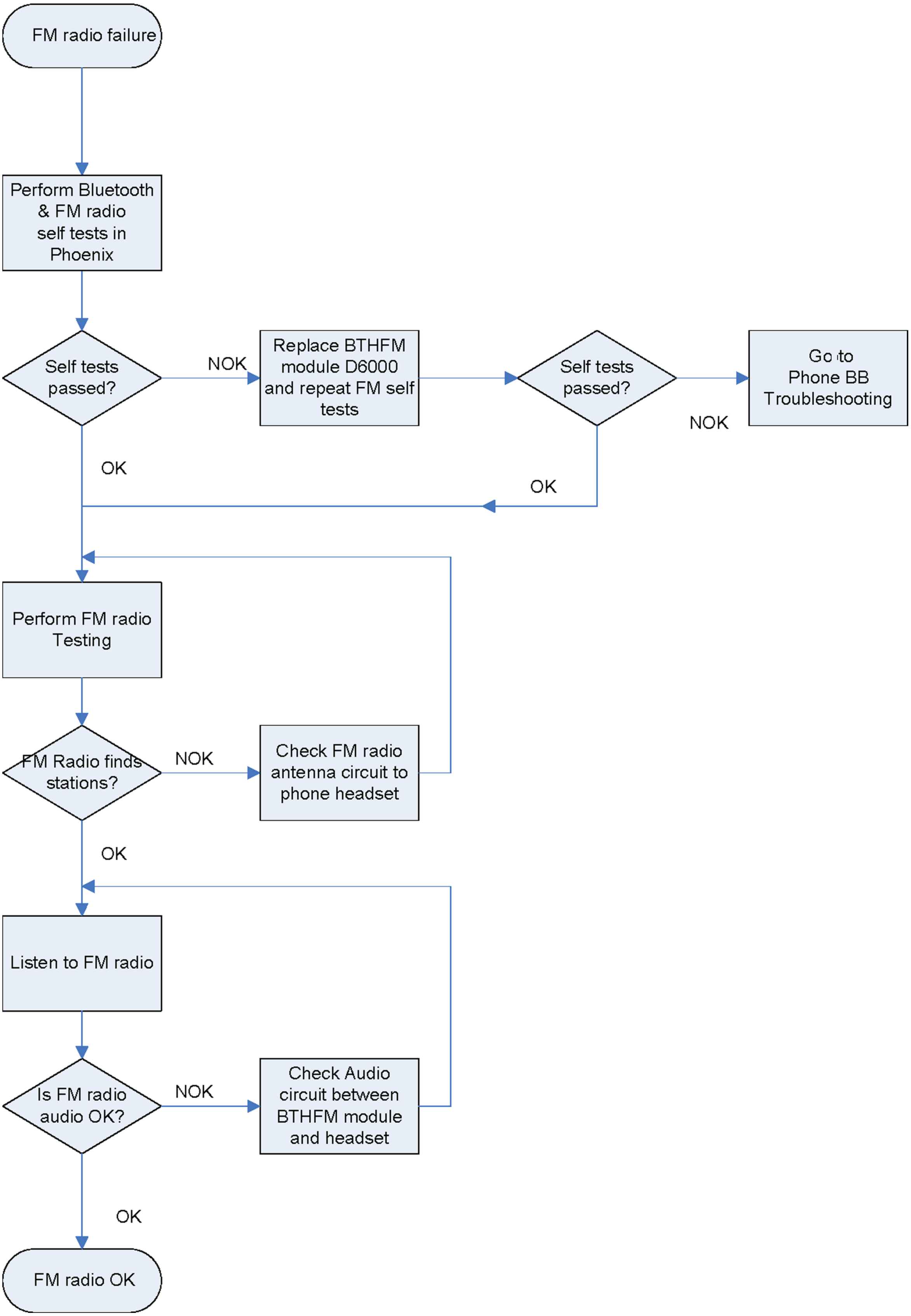
Bluetooth troubleshooting

Troubleshooting flow


Bluetooth failure
Perform C-Cover Inspection
Visual inspection passed?
NOK
Replace C-cover
OK
Perform Bluetooth self tests in Phoenix
Self tests passed?
NOK
Replace BTHFM module D6000 and repeat BTH+FM self tests
Self tests passed?
NOK
Goto Phone BB Troubleshooting
OK
OK
Perform BTH BER Test
BER test passed?
NOK
Check Bluetooth antenna line and/or replace pogo pin.
BER test passed?
NOK
Goto Phone BB Troubleshooting
OK
OK
Bluetooth OK

FM radio troubleshooting

Troubleshooting flow


FM radio failure
Perform Bluetooth & FM radio self tests in Phoenix
Self tests passed?
NOK
Replace BTHFM module D6000 and repeat FM self tests
Self tests passed?
NOK
Go to Phone BB Troubleshooting
OK
OK
Perform FM radio Testing
FM Radio finds stations?
NOK
Check FM radio antenna circuit to phone headset
OK
Listen to FM radio
Is FM radio audio OK?
NOK
Check Audio circuit between BTHFM module and headset
OK
FM radio OK

FM radio testing

Steps

1. Set signal generator parameters:
    - FM modulation on
    - Frequency 100MHz
    - FM deviation 22kHz
    - Modulation frequency 1kHz
    - RF level should be varied during the test to obtain good audio signal quality
    - Connect suitable antenna to signal generator

      Note: You may alternately use a known good FM radio broadcast as a test signal.
2. Attach the Nokia headset to the phone's AV connector.
3. Use Scroll button to autotune to the radio frequency.
4. Set volume to suitable level.
5. Check audio quality with a headset.

GPS Troubleshooting

GPS layout and basic test points

The GPS components are located on small 2nd PWB. Satellite signals are picked up by the phones GPS antenna in the C-cover. The signal is then routed through a filter before being processed by the GPS5350 receiver ASIC. Verify that the GPS voltage and clock signal levels are as in RM-333 GPS schematics.

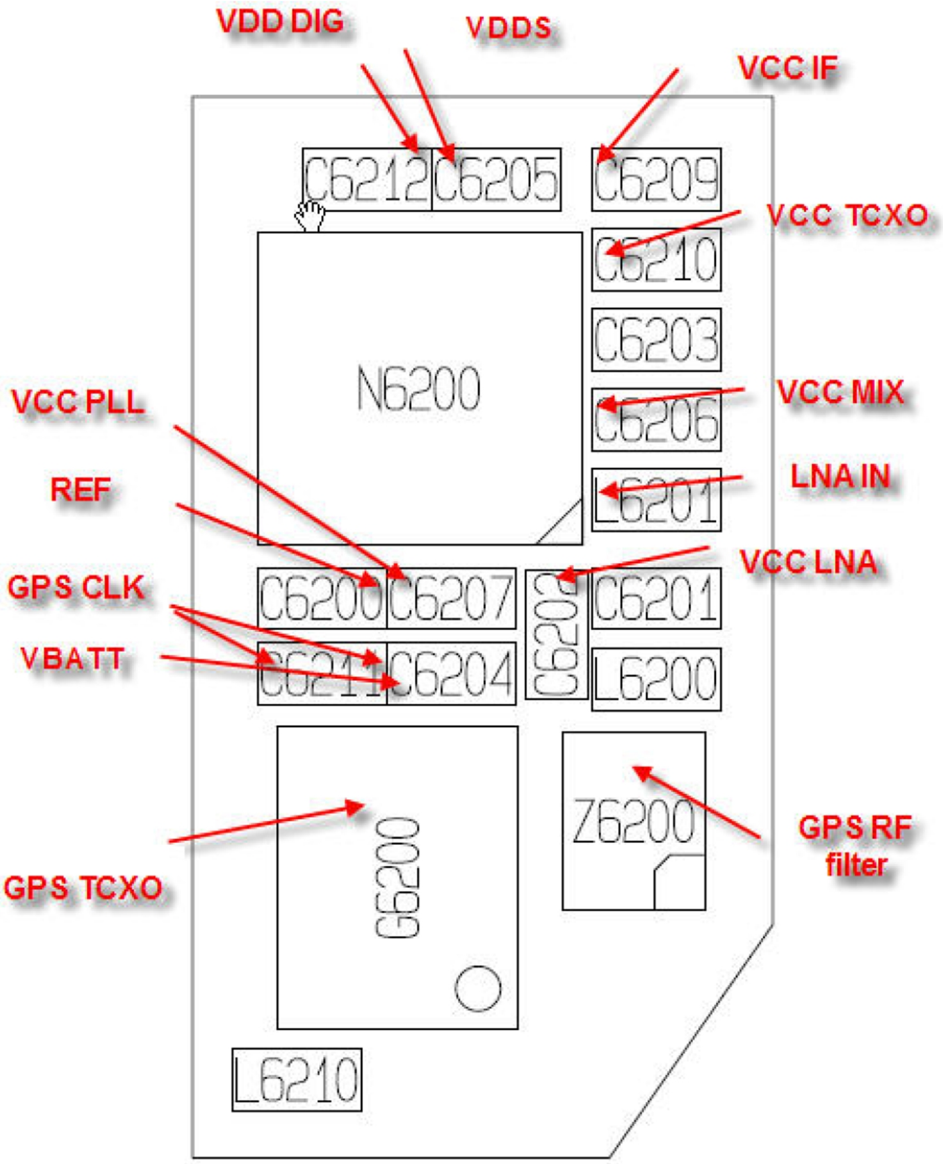

VDD DIG
VDDS
VCC IF
VCC TCXO
VCC MIX
LNA IN
VCC LNA
VCC PLL
REF
GPS CLK
VBATT
GPS TCXO
GPS RF filter
C6212
C6205
C6209
C6210
C6203
C6206
L6201
N6200
C6200
C6207
C6202
C6201
C6211
C6204
L6200
G6200
Z6200
L6210

Figure 22 GPS layout and basic test points

GPS Settings for Phoenix

GPS control

Prerequisites

A flash adapter with RF coupler connected to a PC with Phoenix service software is required. The GPS signal should be connected to the RF coupler. Calibrate the signal level with a known good phone. Signal level will be high (approx -45dBm) because it is a leakage connection.

Context

Use the following to test GPS using Phoenix.

Steps

1. Place phone to Flash Adaptor.
2. Start Phoenix service software.

3. From the **File** menu, select **Scan Product** and check that the correct product version is displayed.
4. From the **Testing** menu, select **GPS Control**. This opens up *GPS Control* dialogue box, as shown in the figure below, and enables the GPS.

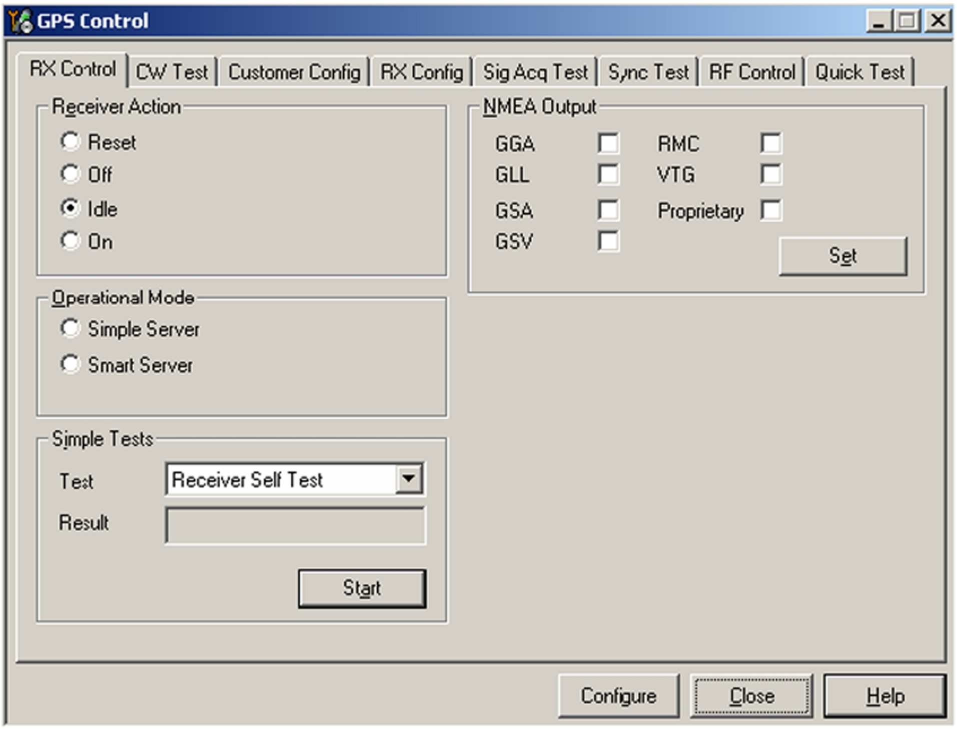

GPS Control
RX Control | CW Test | Customer Config | RX Config | Sig Acq Test | Sync Test | RF Control | Quick Test
Receiver Action
○ Reset
○ Off
● Idle
○ On
NMEA Output
GGA ☐
GLL ☐
GSA ☐
GSV ☐
RMC ☐
VTG ☐
Proprietary ☐
Set
Operational Mode
○ Simple Server
○ Smart Server
Simple Tests
Test: Receiver Self Test
Result
Start
Configure
Close
Help

Figure 23 GPS Control dialogue box

Select **Idle** to confirm the GPS is enabled and is in idle mode; at this point all clocks should be present, GPS_En_Reset & SleepX should be high, and Vdd_Dig, Vcc_TCXO & Vcc_PLL/VCO will be present.

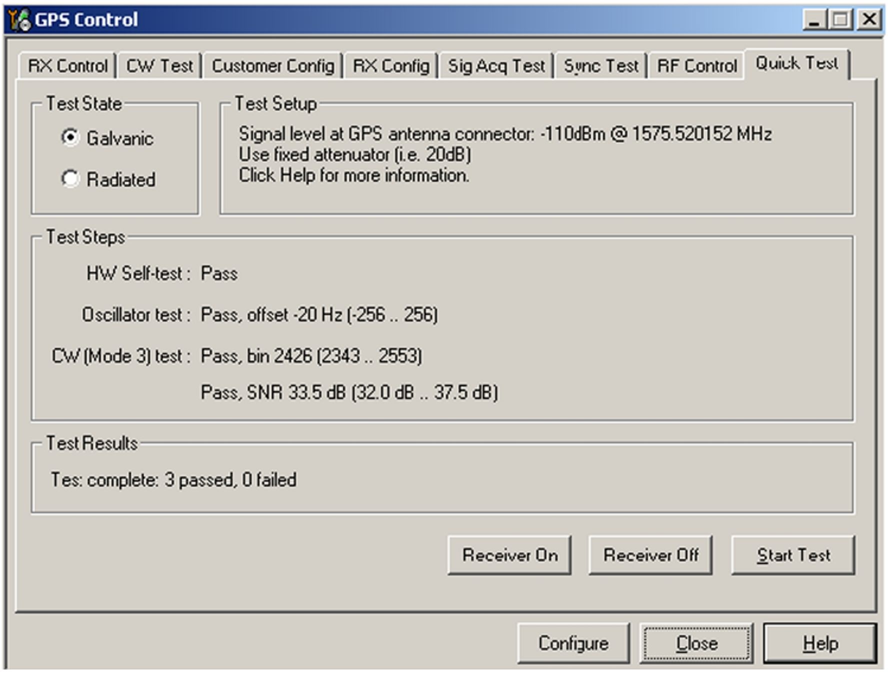
Receiver On turns on all RF sections of the ASIC and so all LDOs will be on.

Quick Test window

This test will perform 3 tests in one: Self test, Oscillator Test and CW Test and will provide a Pass/Fail Response for each. The HW Self Test confirms basic communication with the GPS ASIC. The oscillator test confirms the frequency accuracy of the GPS TCXO against the Ref_Clk. The CW Test confirms end-to-end connectivity between the GPS antenna pogo pins and the GPS ASIC. It also contains a receive button.

Before this test is performed a known good phone should be tested in order to calibrate the setup. The signal level of the Signal Generator should be adjusted so a reading of SNR 40 dB is achieved with the reference unit. A good starting point is to set up the signal generator to -45dBm.

These checks are part of GPS failure troubleshooting (page 3–59).


GPS Control
RX Control
CW Test
Customer Config
RX Config
Sig Acq Test
Sync Test
RF Control
Quick Test
Receiver On
Receiver Off
Start Test
Configure
Close
Help

Test State
● Galvanic
○ Radiated

Test Setup
Signal level at GPS antenna connector: -110dBm @ 1575.520152 MHz
Use fixed attenuator (i.e. 20dB)
Click Help for more information.

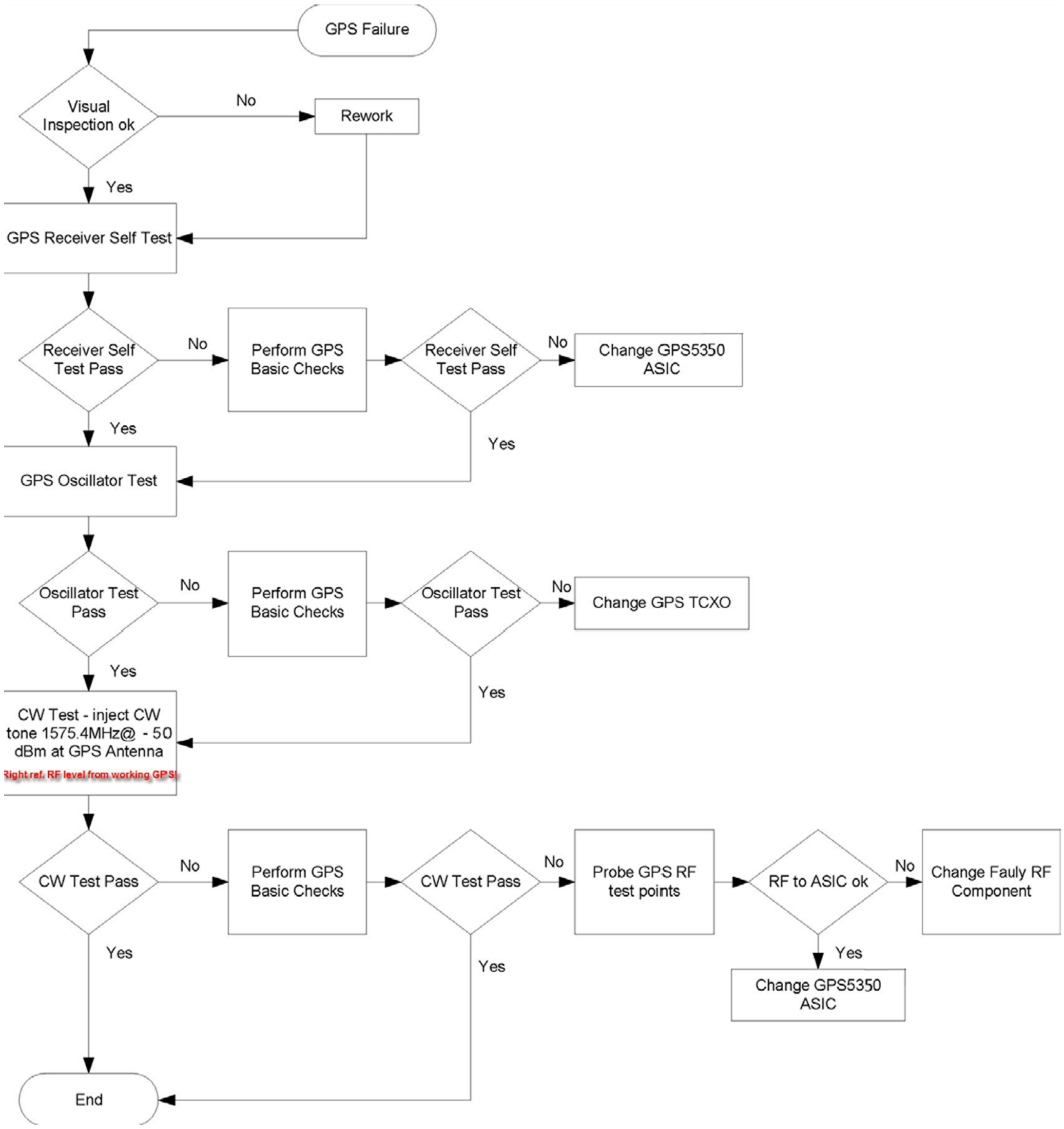
Test Steps
HW Self-test : Pass
Oscillator test : Pass, offset -20 Hz (-256 .. 256)
CW (Mode 3) test : Pass, bin 2426 (2343 .. 2553)
Pass, SNR 33.5 dB (32.0 dB .. 37.5 dB)

Test Results
Test complete: 3 passed, 0 failed

Figure 24 GPS Quick Test window

GPS failure troubleshooting

Troubleshooting flow


GPS Failure
Visual Inspection ok
No
Rework
Yes
GPS Receiver Self Test
Receiver Self Test Pass
No
Perform GPS Basic Checks
Receiver Self Test Pass
No
Change GPS5350 ASIC
Yes
Yes
GPS Oscillator Test
Oscillator Test Pass
No
Perform GPS Basic Checks
Oscillator Test Pass
No
Change GPS TCXO
Yes
Yes
CW Test - inject CW tone 1575.4MHz@ - 50 dBm at GPS Antenna
Right ref. RF level from working GPS!
CW Test Pass
No
Perform GPS Basic Checks
CW Test Pass
No
Probe GPS RF test points
RF to ASIC ok
No
Change Fauly RF Component
Yes
Change GPS5350 ASIC
Yes
Yes
End

WLAN Troubleshooting

WLAN functional description

The Size 4 WLAN module is designed for use with a single antenna shared between itself and a co-located BT device. The WLAN SW is downloaded from the host engine when the WLAN is turned on over the dedicated SPI interface. BT and WLAN have their own 38,4MHz TCXO.

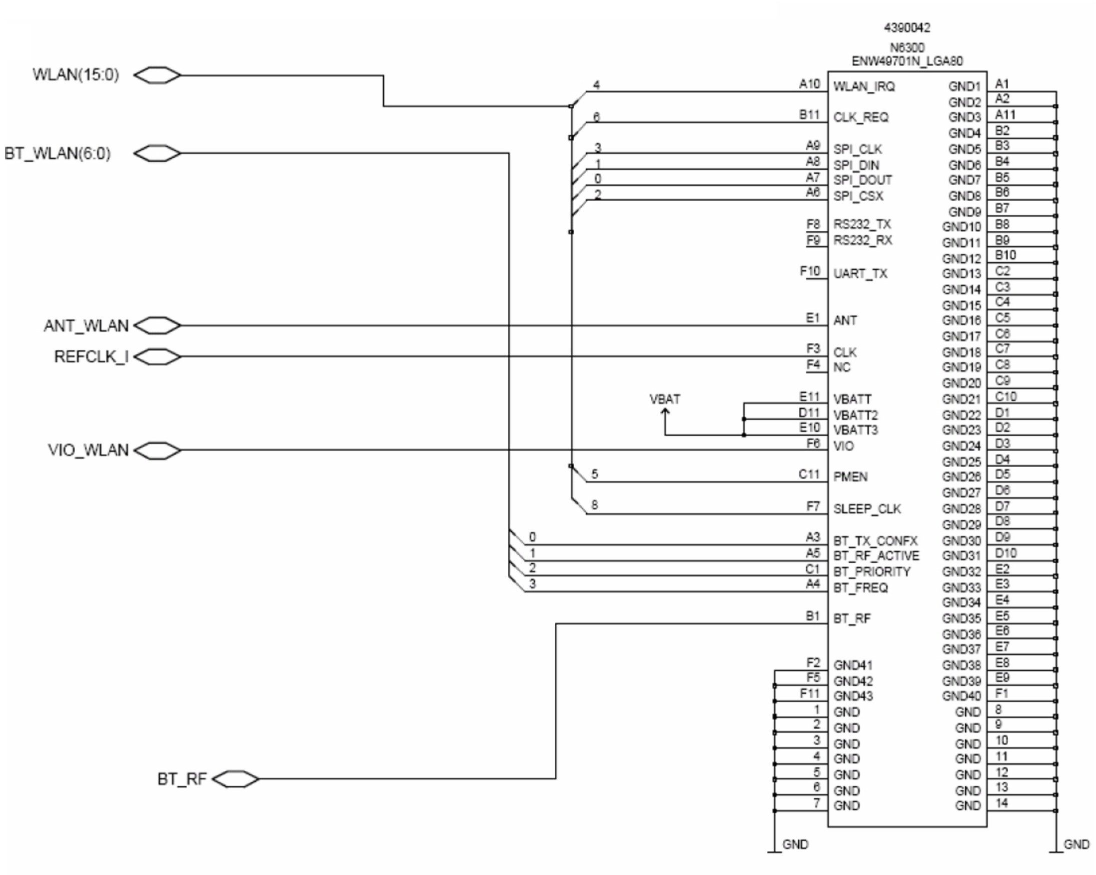

4390042
N6300
ENW49701N_LGA80
WLAN(15:0)
BT_WLAN(6:0)
ANT_WLAN
REFCLK_I
VIO_WLAN
BT_RF
VBAT
A10 WLAN_IRQ
B11 CLK_REQ
A9 SPI_CLK
A8 SPI_DIN
A7 SPI_DOUT
A6 SPI_CSX
F8 RS232_TX
F9 RS232_RX
F10 UART_TX
E1 ANT
F3 CLK
F4 NC
E11 VBATT
D11 VBATT2
E10 VBATT3
F6 VIO
C11 PMEN
F7 SLEEP_CLK
A3 BT_TX_CONFX
A5 BT_RF_ACTIVE
C1 BT_PRIORITY
A4 BT_FREQ
B1 BT_RF
F2 GND41
F5 GND42
F11 GND43
GND
GND1
GND2
GND3
GND40
A1
A2
A11
F1
GND

Figure 25 WLAN circuitry

WLAN settings for Phoenix

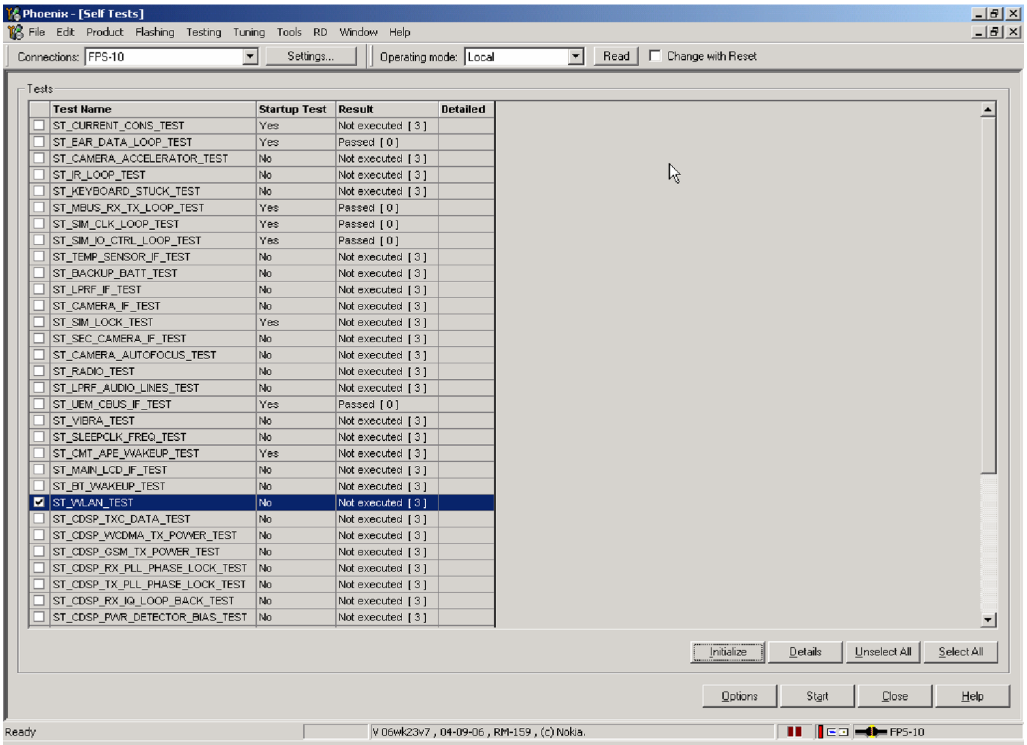
Use the following to test WLAN using Phoenix:

1 Set phone into Local Mode .

2 From the **File** menu, select **Scan Product** and check that the correct product version is displayed

3 From the **Testing** menu, select **Self Test**. This opens up a Self Test dialogue box, as shown below.

Select the **ST_WLAN_TEST** check box as shown and then select **Start** button. The test turns on the WLAN, sets up the SPI interface and then downloads the WLAN firmware into the WLAN module. During the download the WLAN acknowledges the data blocks and so the self test is a good way to confirm that the WLAN module is communicating with the Host. The result column will change to **Passed** after a few seconds if operating properly.


Phoenix - [Self Tests]
File Edit Product Flashing Testing Tuning Tools RD Window Help
Connections: FPS-10
Settings...
Operating mode: Local
Read
Change with Reset
Tests
Initialize
Details
Unselect All
Select All
Options
Start
Close
Help
Ready
FPS-10

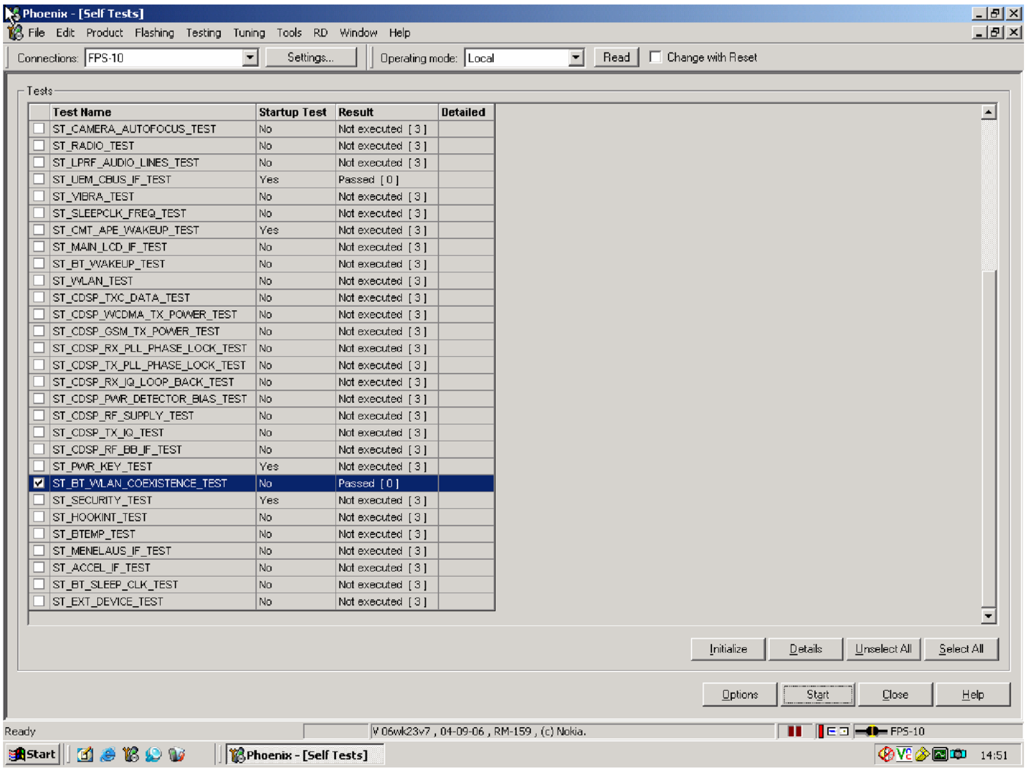
	Test Name	Startup Test	Result	Detailed
☐	ST_CURRENT_CONS_TEST	Yes	Not executed [3]	
☐	ST_EAR_DATA_LOOP_TEST	Yes	Passed [0]	
☐	ST_CAMERA_ACCELERATOR_TEST	No	Not executed [3]	
☐	ST_IR_LOOP_TEST	No	Not executed [3]	
☐	ST_KEYBOARD_STUCK_TEST	No	Not executed [3]	
☐	ST_MBUS_RX_TX_LOOP_TEST	Yes	Passed [0]	
☐	ST_SIM_CLK_LOOP_TEST	Yes	Passed [0]	
☐	ST_SIM_IO_CTRL_LOOP_TEST	Yes	Passed [0]	
☐	ST_TEMP_SENSOR_IF_TEST	No	Not executed [3]	
☐	ST_BACKUP_BATT_TEST	No	Not executed [3]	
☐	ST_LPRF_IF_TEST	No	Not executed [3]	
☐	ST_CAMERA_IF_TEST	No	Not executed [3]	
☐	ST_SIM_LOCK_TEST	Yes	Not executed [3]	
☐	ST_SEC_CAMERA_IF_TEST	No	Not executed [3]	
☐	ST_CAMERA_AUTOFOCUS_TEST	No	Not executed [3]	
☐	ST_RADIO_TEST	No	Not executed [3]	
☐	ST_LPRF_AUDIO_LINES_TEST	No	Not executed [3]	
☐	ST_UEM_CBUS_IF_TEST	Yes	Passed [0]	
☐	ST_VIBRA_TEST	No	Not executed [3]	
☐	ST_SLEEPCLK_FREQ_TEST	No	Not executed [3]	
☐	ST_CMT_APE_WAKEUP_TEST	Yes	Not executed [3]	
☐	ST_MAIN_LCD_IF_TEST	No	Not executed [3]	
☐	ST_BT_WAKEUP_TEST	No	Not executed [3]	
☑	ST_WLAN_TEST	No	Not executed [3]	
☐	ST_CDSP_TXC_DATA_TEST	No	Not executed [3]	
☐	ST_CDSP_WCDMA_TX_POWER_TEST	No	Not executed [3]	
☐	ST_CDSP_GSM_TX_POWER_TEST	No	Not executed [3]	
☐	ST_CDSP_RX_PLL_PHASE_LOCK_TEST	No	Not executed [3]	
☐	ST_CDSP_TX_PLL_PHASE_LOCK_TEST	No	Not executed [3]	
☐	ST_CDSP_RX_IQ_LOOP_BACK_TEST	No	Not executed [3]	
☐	ST_CDSP_PWR_DETECTOR_BIAS_TEST	No	Not executed [3]	

V 06wk23v7 , 04-09-06 , RM-159 , (c) Nokia.

In addition, a test of the WLAN to BTH interface can be done by selecting the **ST_BT_WLAN_COEXISTENCE_TEST** check box and selecting Start button.

This test verifies that the WLAN to BTH co-existence interface signals are properly connected and there are no open circuit or shorts on the four interface signals.

The co-existence interface comprises BTH Txconfig, BTH RF Active, BTH Priority, and BTH Frequency.


Phoenix - [Self Tests]
File Edit Product Flashing Testing Tuning Tools RD Window Help
Connections: FPS-10
Settings...
Operating mode: Local
Read
Change with Reset
Tests
Initialize
Details
Unselect All
Select All
Options
Start
Close
Help
Ready
FPS-10
Start
Phoenix - [Self Tests]
14:51

	Test Name	Startup Test	Result	Detailed
☐	ST_CAMERA_AUTOFOCUS_TEST	No	Not executed [3]	
☐	ST_RADIO_TEST	No	Not executed [3]	
☐	ST_LPRF_AUDIO_LINES_TEST	No	Not executed [3]	
☐	ST_UEM_CBUS_IF_TEST	Yes	Passed [0]	
☐	ST_VIBRA_TEST	No	Not executed [3]	
☐	ST_SLEEPCLK_FREQ_TEST	No	Not executed [3]	
☐	ST_CMT_APE_WAKEUP_TEST	Yes	Not executed [3]	
☐	ST_MAIN_LCD_IF_TEST	No	Not executed [3]	
☐	ST_BT_WAKEUP_TEST	No	Not executed [3]	
☐	ST_WLAN_TEST	No	Not executed [3]	
☐	ST_CDSP_TXC_DATA_TEST	No	Not executed [3]	
☐	ST_CDSP_WCDMA_TX_POWER_TEST	No	Not executed [3]	
☐	ST_CDSP_GSM_TX_POWER_TEST	No	Not executed [3]	
☐	ST_CDSP_RX_PLL_PHASE_LOCK_TEST	No	Not executed [3]	
☐	ST_CDSP_TX_PLL_PHASE_LOCK_TEST	No	Not executed [3]	
☐	ST_CDSP_RX_IQ_LOOP_BACK_TEST	No	Not executed [3]	
☐	ST_CDSP_PWR_DETECTOR_BIAS_TEST	No	Not executed [3]	
☐	ST_CDSP_RF_SUPPLY_TEST	No	Not executed [3]	
☐	ST_CDSP_TX_IQ_TEST	No	Not executed [3]	
☐	ST_CDSP_RF_BB_IF_TEST	No	Not executed [3]	
☐	ST_PWR_KEY_TEST	Yes	Not executed [3]	
☑	ST_BT_WLAN_COEXISTENCE_TEST	No	Passed [0]	
☐	ST_SECURITY_TEST	Yes	Not executed [3]	
☐	ST_HOOKINT_TEST	No	Not executed [3]	
☐	ST_BTEMP_TEST	No	Not executed [3]	
☐	ST_MENELAUS_IF_TEST	No	Not executed [3]	
☐	ST_ACCEL_IF_TEST	No	Not executed [3]	
☐	ST_BT_SLEEP_CLK_TEST	No	Not executed [3]	
☐	ST_EXT_DEVICE_TEST	No	Not executed [3]	

V 06wk23v7 , 04-09-06 , RM-159 , (c) Nokia.

In summary these two Self tests provide a simple means of ensuring the Host engine is able to communicate with the WLAN module and check the interface to BTH. More detailed WLAN performance test is covered in WLAN functional test section.

WLAN functional tests

On/Off test

Prerequisites

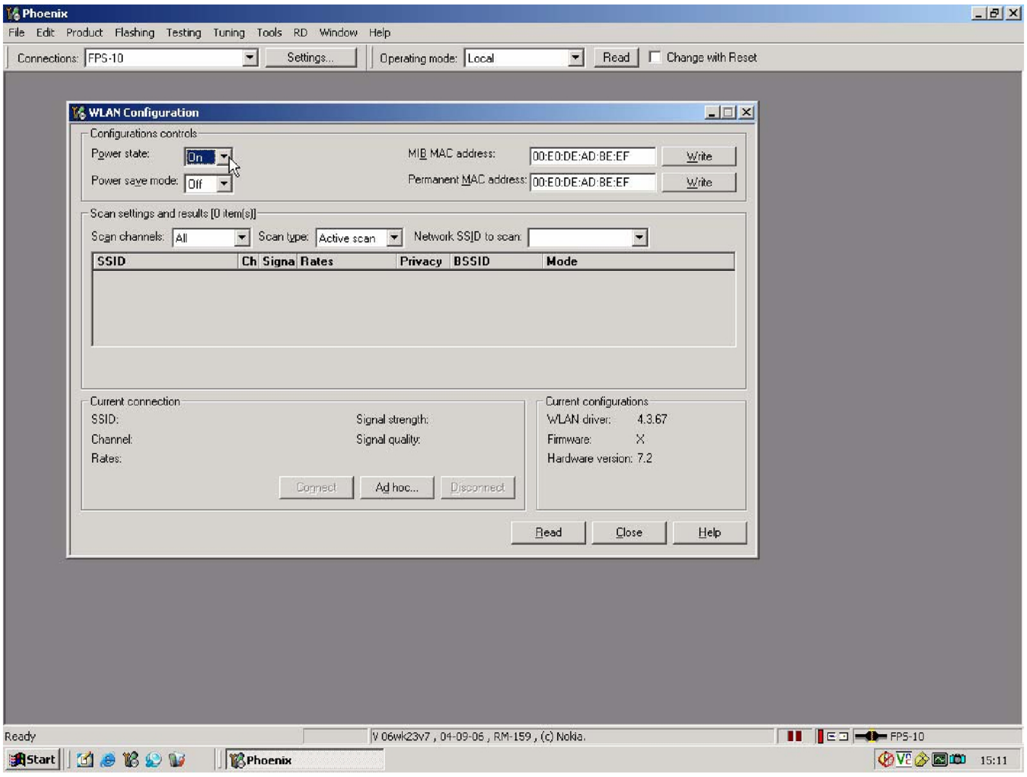
A flash adapter connected to a PC with Phoenix service software is required.

From the testing toolbar select **WLAN Configuration** option. This opens the WLAN configuration dialogue box below. Selecting the Power state option button (as indicated), the WLAN can be turned ON and OFF:

1 With Power State set to OFF, measure the dc power supply current consumption of the flash adaptor.

2 Next return the Power state to ON and re-measure the dc power supply current of the flash adaptor.

The difference between the currents in (1) and (2) should be between 190 to 220mA. When WLAN is ON, the firmware has been downloaded and the WLAN module is in the receive state. When OFF WLAN is powered down.


Phoenix
File Edit Product Flashing Testing Tuning Tools RD Window Help
Settings...
Read
☐ Change with Reset
WLAN Configuration
Configurations controls
Scan settings and results [0 item(s)]
SSID Ch Signa Rates Privacy BSSID Mode
Current connection
Connect
Ad hoc...
Disconnect
Current configurations
Write
Write
Read
Close
Help
Ready
Start
Phoenix
15:11

Connections: FPS-10
Operating mode: Local
Power state: On
Power save mode: Off
MIB MAC address: 00:E0:DE:AD:BE:EF
Permanent MAC address: 00:E0:DE:AD:BE:EF
Scan channels: All
Scan type: Active scan
Network SSID to scan:
SSID:
Channel:
Rates:
Signal strength:
Signal quality:
WLAN driver: 4.3.67
Firmware: X
Hardware version: 7.2
V 06wk23v7 , 04-09-06 , RM-159 , (c) Nokia.
FPS-10

TX tests

Prerequisites

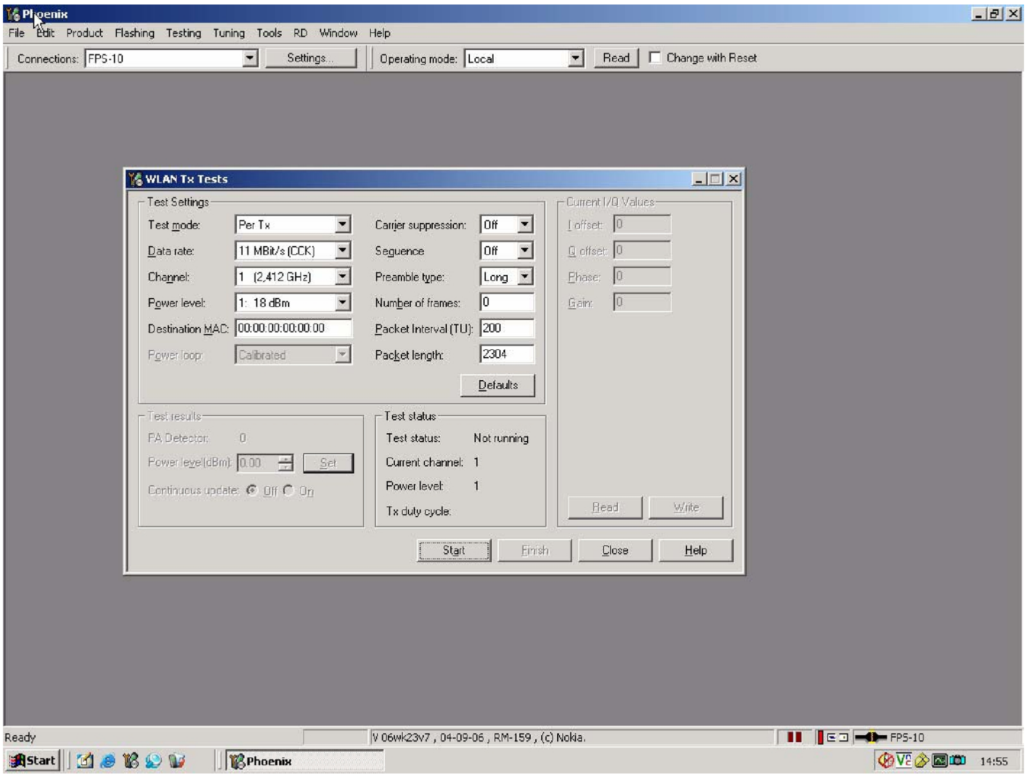
Connect complete phone assembly with C-cover to a PC with Phoenix service software using a USB data cable.

From the testing toolbar select WLAN Tx Test option shown below. This test can be used to verify TX configuration and functionality. The default settings are sufficient for testing the TX operation, although other channels and data rates are equally suitable. To start the test, select the Start option button:

1 Monitor the WLAN TX spectrum on a Spectrum analyser. (When making a radiated test ensure that other WLAN devices are not transmitting as these may be detected as well, confusing the result). A typical 11MBPS TX spectrum is shown in figure below.

2 To finish the test select the Finish option button.

The difference between the two readings should be approximately 150mA and measures the transmit current in 11MBPS, 802.11b mode of operation.


Phoenix
File Edit Product Flashing Testing Tuning Tools RD Window Help
Settings...
Read
☐ Change with Reset
WLAN Tx Tests
Test Settings
Current I/Q Values
Defaults
Test results
Test status
Set
Read
Write
Start
Finish
Close
Help
Start
Phoenix
14:55

Connections: FPS-10

Operating mode: Local

Test mode: Per Tx

Data rate: 11 MBit/s (CCK)

Channel: 1 (2,412 GHz)

Power level: 1: 18 dBm

Destination MAC: 00:00:00:00:00:00

Power loop: Calibrated

Carrier suppression: Off

Sequence: Off

Preamble type: Long

Number of frames: 0

Packet Interval (TU): 200

Packet length: 2304

I offset: 0

Q offset: 0

Phase: 0

Gain: 0

PA Detector: 0

Power level(dBm): 0.00

Continuous update: ● Off ○ On

Test status: Not running

Current channel: 1

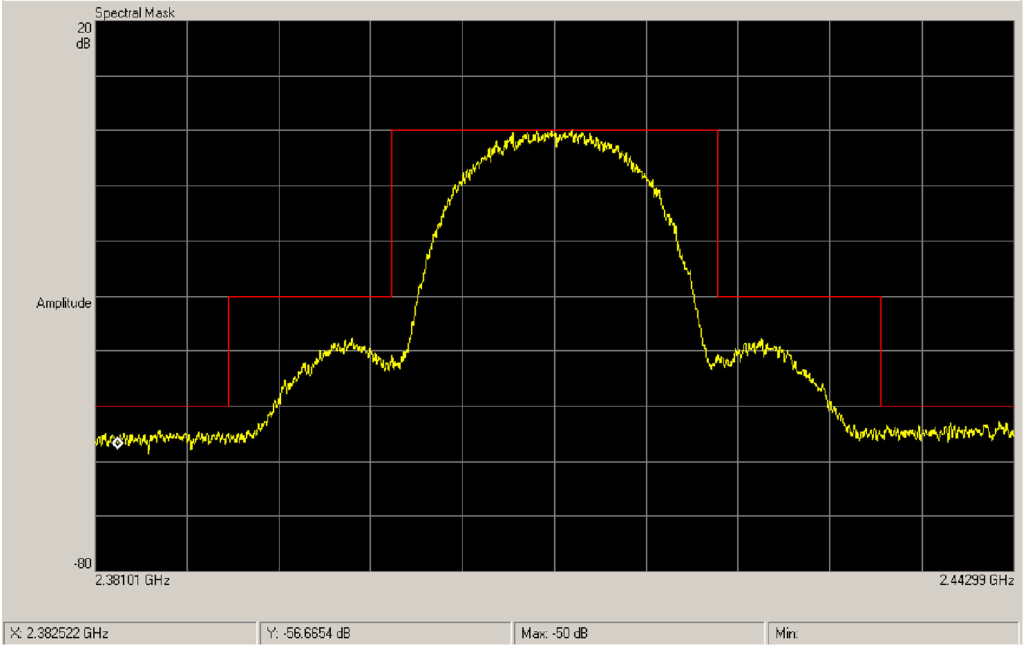
Power level: 1

Tx duty cycle:

Ready

V 06wk23v7 , 04-09-06 , RM-159 , (c) Nokia.

FPS-10



RX Tests

Prerequisites

Connect complete phone assembly with C-cover to a PC with Phoenix service software using a USB data cable.

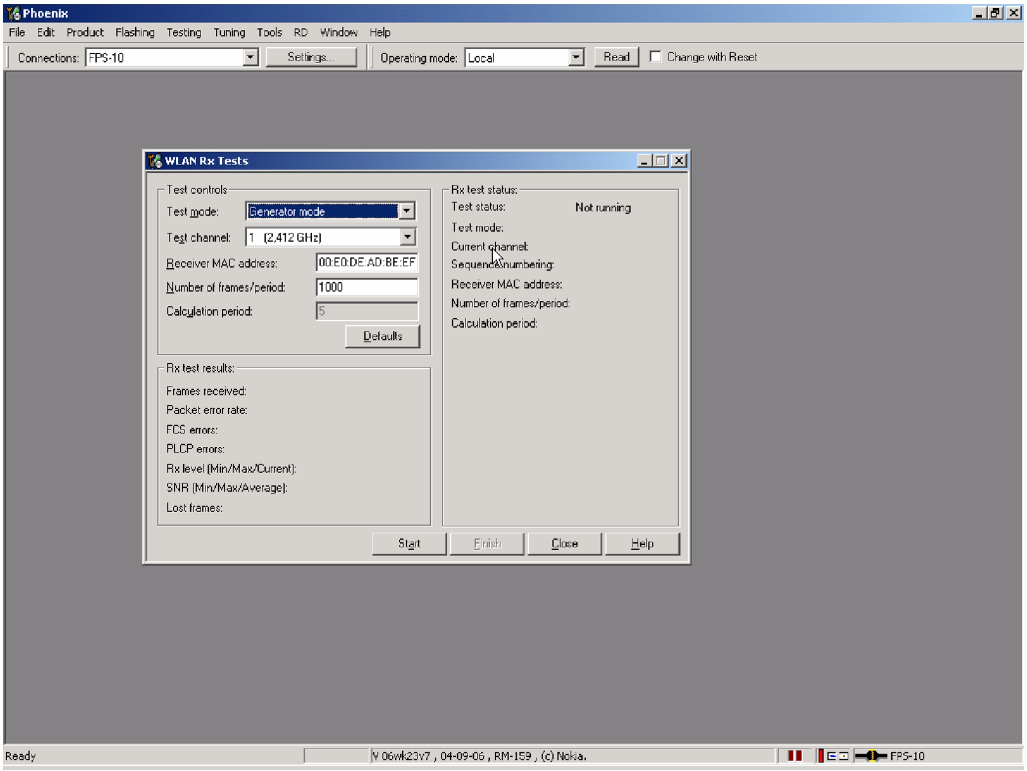
There are different options available for testing the Rx path. The simplest is to use the WLAN to report Rx packets when operating in an area where there is an active WLAN network. Simply starting an Rx test will show the number of packets detected by the WLAN module as it monitors the network. However, it does require a properly configured WLAN network.

From the testing toolbar select WLAN Rx Test option shown below. This test can be used to verify Rx configuration and functionality.

To start the test, select the Start option button.

As the WLAN monitors an active WLAN network, the Rx test results window will update and show the number of Frames received, as well as the Packer error rate.

Monitoring the detected frames is a simple method to verify the WLAN antenna and receiver path is working properly.



Connections: FPS-10

Operating mode: Local

☐ Change with Reset

Test mode: Generator mode

Test channel: 1 (2,412 GHz)

Receiver MAC address: 00:E0:DE:AD:BE:EF

Number of frames/period: 1000

Calculation period: 5

Frames received:
Packet error rate:
FCS errors:
PLCP errors:
Rx level (Min/Max/Current):
SNR (Min/Max/Average):
Lost frames:

Test status: Not running
Test mode:
Current channel:
Sequence numbering:
Receiver MAC address:
Number of frames/period:
Calculation period:

V 06wk23v7 , 04-09-06 , RM-159 , (c) Nokia.

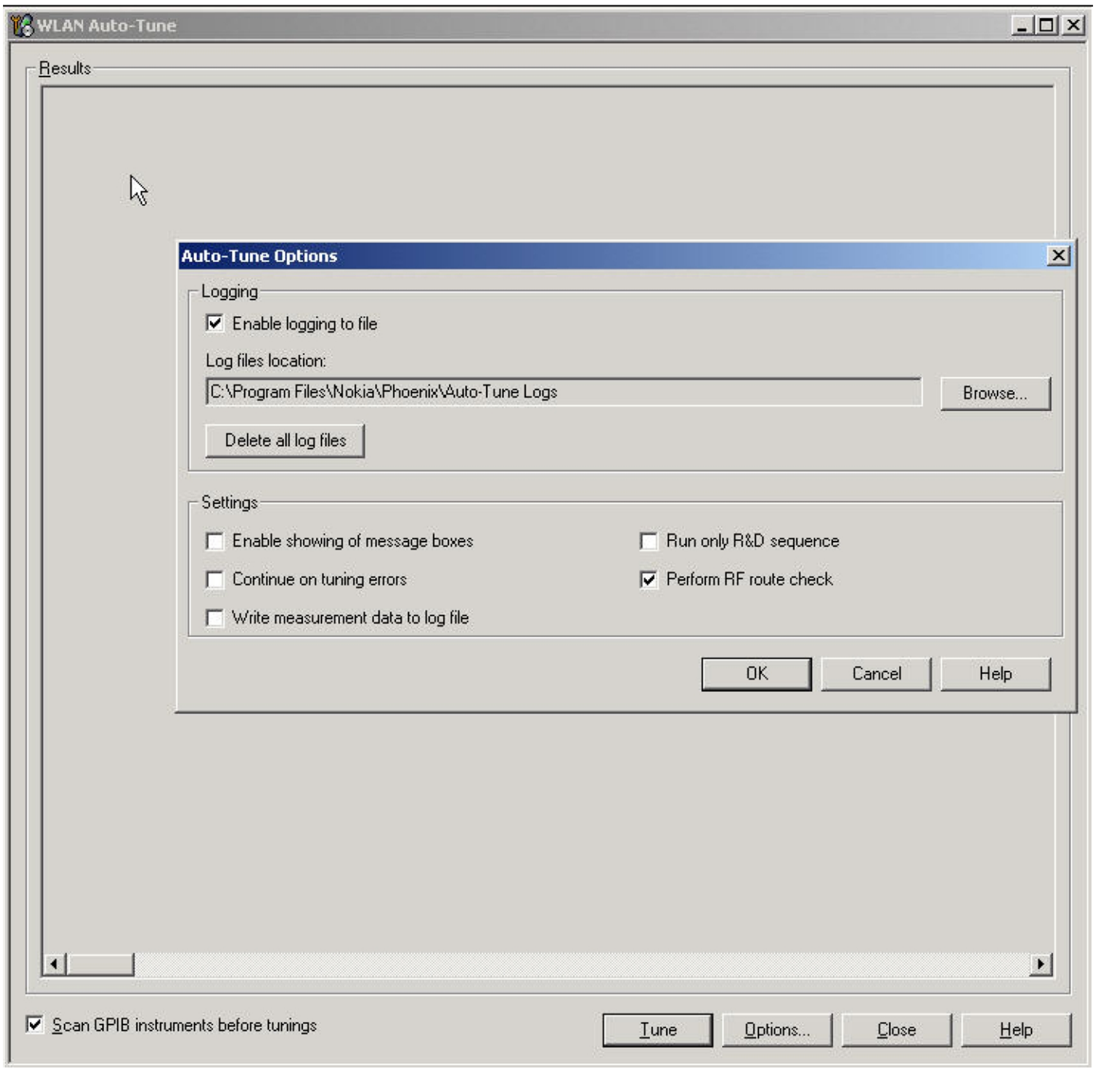
FPS-10

WLAN auto tuning

In case of WLAN ASIC change, RF power auto tuning is needed. Connect WLAN RF test connector to CMU200 input using proper RF cable. Start Phoenix WLAN autotune window. Check the settings and verify your PC communicates with CMU200 via GPIB.

Auto tuning procedure

1 Start tuning by pressing **Tune**.



WLAN Auto-Tune

Results

Auto-Tune Options

Logging

☑ Enable logging to file

Log files location:

C:\Program Files\Nokia\Phoenix\Auto-Tune Logs

Settings

☐ Enable showing of message boxes

☐ Continue on tuning errors

☐ Write measurement data to log file

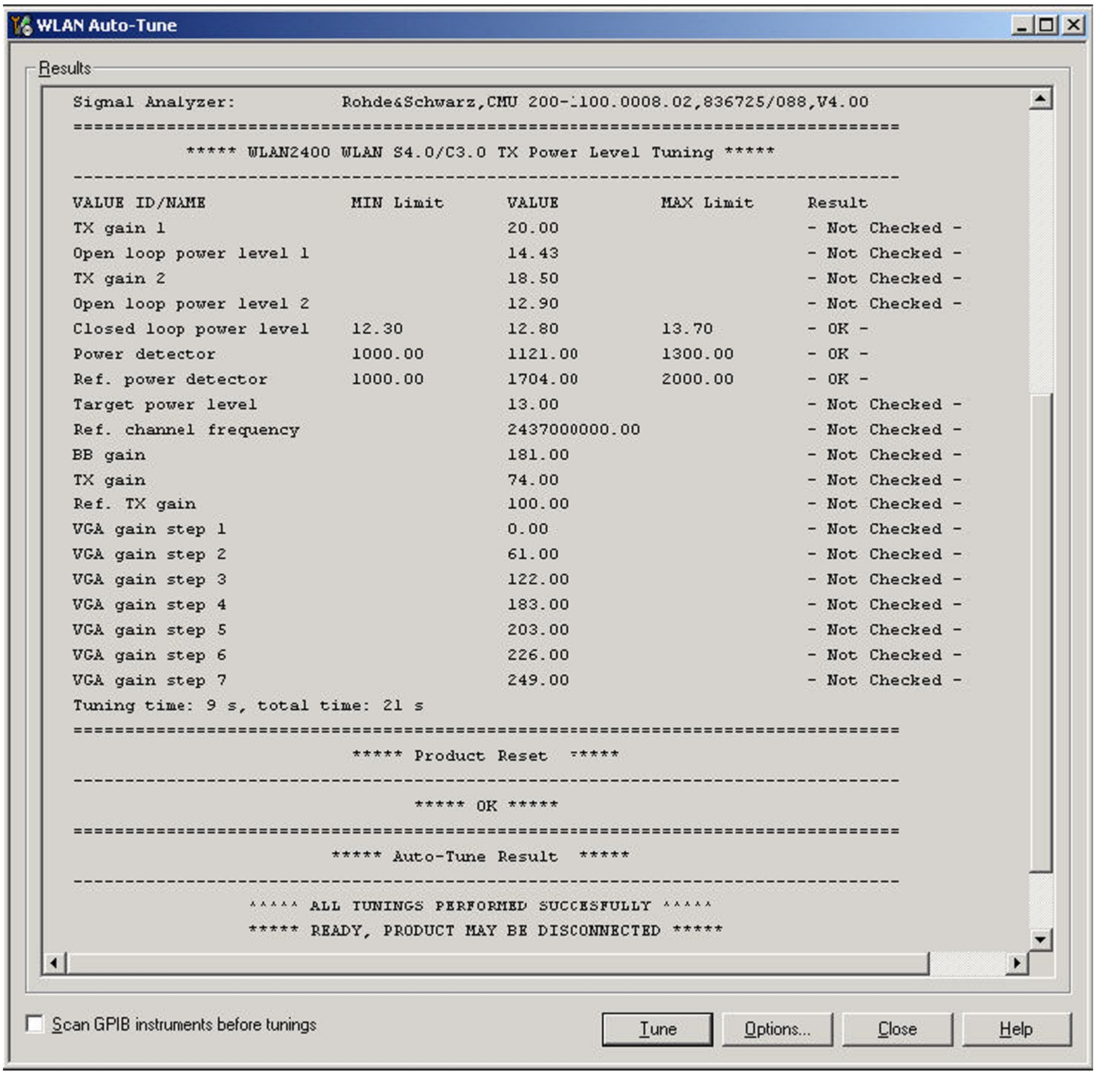
☐ Run only R&D sequence

☑ Perform RF route check

☑ Scan GPIB instruments before tunings

Browse...
Delete all log files
OK
Cancel
Help
Tune
Options...
Close
Help

Figure 26 WLAN auto tune settings



```
Signal Analyzer:          Rohde&Schwarz,CMU 200-1100.0008.02,836725/088,V4.00
================================================================================
           ***** WLAN2400 WLAN S4.0/C3.0 TX Power Level Tuning *****
--------------------------------------------------------------------------------
VALUE ID/NAME              MIN Limit      VALUE          MAX Limit     Result
TX gain 1                                 20.00                        - Not Checked -
Open loop power level 1                   14.43                        - Not Checked -
TX gain 2                                 18.50                        - Not Checked -
Open loop power level 2                   12.90                        - Not Checked -
Closed loop power level    12.30          12.80          13.70         - OK -
Power detector             1000.00        1121.00        1300.00       - OK -
Ref. power detector        1000.00        1704.00        2000.00       - OK -
Target power level                        13.00                        - Not Checked -
Ref. channel frequency                    2437000000.00                - Not Checked -
BB gain                                   181.00                       - Not Checked -
TX gain                                   74.00                        - Not Checked -
Ref. TX gain                              100.00                       - Not Checked -
VGA gain step 1                           0.00                         - Not Checked -
VGA gain step 2                           61.00                        - Not Checked -
VGA gain step 3                           122.00                       - Not Checked -
VGA gain step 4                           183.00                       - Not Checked -
VGA gain step 5                           203.00                       - Not Checked -
VGA gain step 6                           226.00                       - Not Checked -
VGA gain step 7                           249.00                       - Not Checked -
Tuning time: 9 s, total time: 21 s
================================================================================
                           ***** Product Reset  *****
--------------------------------------------------------------------------------
                                 ***** OK *****
================================================================================
                         ***** Auto-Tune Result  *****
--------------------------------------------------------------------------------
                 ^^^^^ ALL TUNINGS PERFORMED SUCCESFULLY ^^^^^
                 ***** READY, PRODUCT MAY BE DISCONNECTED *****
```

☐ Scan GPIB instruments before tunings

Figure 27 WLAN auto tune results

4 — RF Troubleshooting

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Table of Contents

General RF troubleshooting 4–5
Introduction to RF troubleshooting 4–5
RF key components and test points 4–6
Auto tuning 4–7
Introduction to RF tunings 4–7
Auto tuning 4–7
Self Test Troubleshooting 4–7
Self test troubleshooting 4–7
Receiver Troubleshooting 4–9
Introduction to receiver (RX) troubleshooting 4–9
GSM RX chain activation for manual measurements/GSM RSSI measurement 4–9
GSM receiver troubleshooting flowchart 4–10
WCDMA RX chain activation for manual measurement 4–10
WCDMA RSSI measurement 4–11
WCDMA receiver troubleshooting flowchart 4–13
Transmitter Troubleshooting 4–13
General instructions for transmitter (TX) troubleshooting 4–13
GSM transmitter troubleshooting 4–13
WCDMA transmitter troubleshooting 4–16
Antenna Troubleshooting 4–17
Antenna troubleshooting 4–17

List of Figures

Figure 28 RF key components 4–6
Figure 29 RF test points 4–6
Figure 30 Phoenix GSM RSSI reading window 4–9
Figure 31 Phoenix WCDMA RX Control window 4–11
Figure 32 WCDMA RX generator settings 4–12
Figure 33 Phoenix WCDMA RX power measurement window 4–12
Figure 34 Phoenix GSM RF controls window 4–14
Figure 35 Antenna contacts and matching components 4–18

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General RF troubleshooting

Introduction to RF troubleshooting

Most RF semiconductors are static discharge sensitive

ESD protection must be applied during repair (ground straps and ESD soldering irons).

Measuring equipment

All measurements should be done using:

- An oscilloscope for low frequency and DC measurements. Recommended probe: 10:1, 10Mohm//8pF.
- A radio communication tester including RF generator and spectrum analyser, for example Rohde & Schwarz CMU200. (Alternatively a spectrum analyser and an RF generator can be used. Some tests in this guide are not possible to perform if this solution is chosen).

Note: A mobile phone WCDMA transmitter should never be tested with full TX power (it is only possible to perform the measurements in a good RF-shielded room). Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.

Note: All communication Test Set Screen dumps are from CMU200. Other testers are different.

Note: All measurements with an RF coupler should be performed in an RF-shielded environment because nearby base stations can disturb sensitive receiver measurements. If there is no possibility to use RF shielded environment, testing at frequencies of nearby base stations should be avoided.

Level of repair

The scope of this guideline is to verify functionality of the cellular RF block without removing RF shield.

RF key components and test points

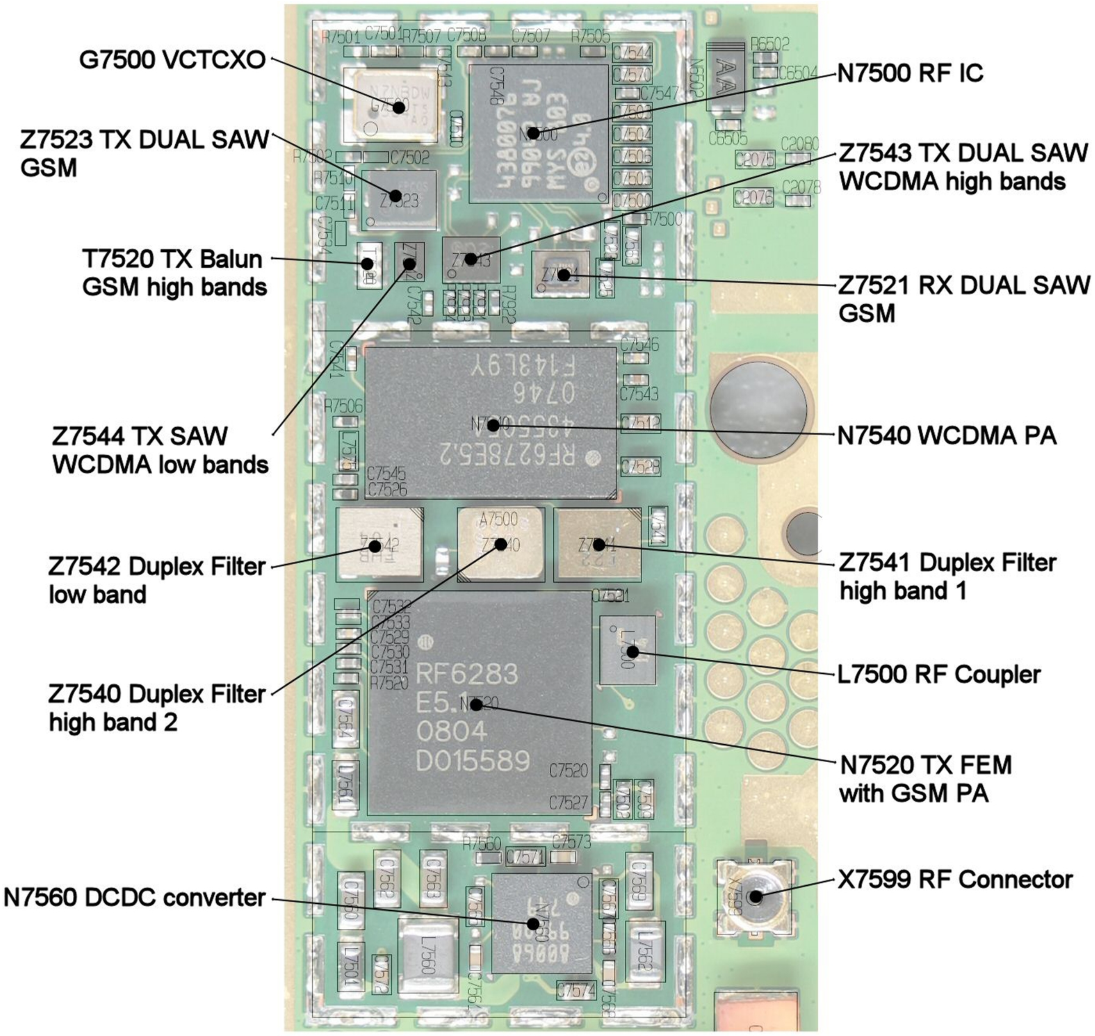

G7500 VCTCXO
Z7523 TX DUAL SAW GSM
T7520 TX Balun GSM high bands
Z7544 TX SAW WCDMA low bands
Z7542 Duplex Filter low band
Z7540 Duplex Filter high band 2
N7560 DCDC converter
N7500 RF IC
Z7543 TX DUAL SAW WCDMA high bands
Z7521 RX DUAL SAW GSM
N7540 WCDMA PA
Z7541 Duplex Filter high band 1
L7500 RF Coupler
N7520 TX FEM with GSM PA
X7599 RF Connector

Figure 28 RF key components

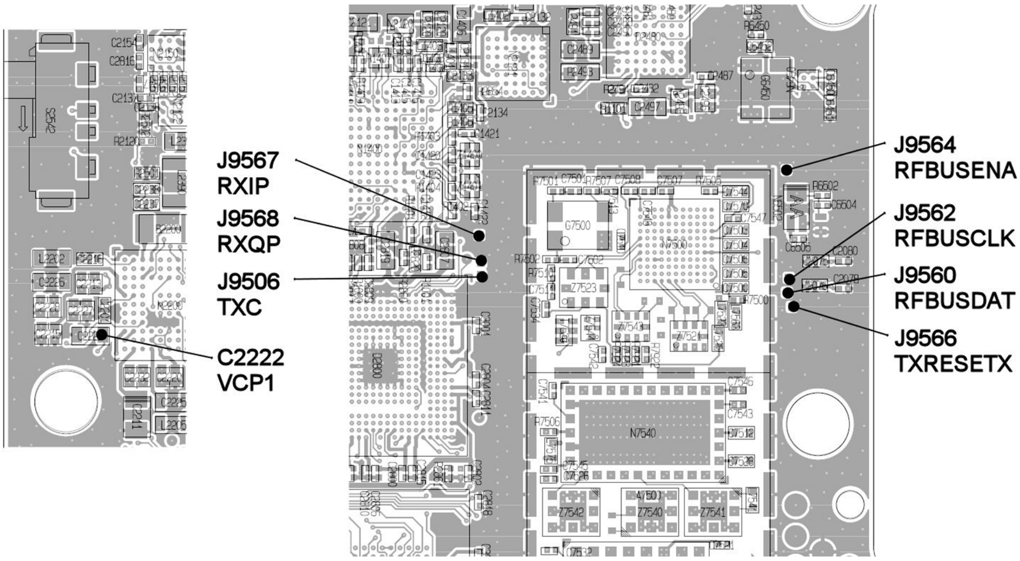

J9567 RXIP
J9568 RXQP
J9506 TXC
C2222 VCP1
J9564 RFBUSENA
J9562 RFBUSCLK
J9560 RFBUSDAT
J9566 TXRESETX

Figure 29 RF test points

Auto tuning

Introduction to RF tunings

RF tuning is always performed with the help of a product-specific module jig, never with an RF coupler. Using an RF coupler in the tuning phase will cause a complete mistuning of the RF part.

Cable and adapter losses

RF cables and adapters have some losses. They have to be taken into account when the phone is tuned. As all RF losses are frequency dependent, the user has to act very carefully and understand the measurement setup. For RF attenuations of the module jig and RF cable, please refer to the Service Tools section.

Auto tuning

This phone can be tuned automatically.

Auto tuning is designed to align the phone's RF part easier and faster. It performs calibrations, tunings and measurements of RX and TX. The results are displayed and logged in a result file, if initiated.

Hardware set up

For hardware requirements for auto tuning, please refer to Service concept for RF testing and RF/BB tuning (page 4–22).

Phoenix preparations

Install the phone specific data package, for example *Nokia_firmware_RM-333_EUROPE_10.014_v41.0.exe*. This defines phone specific settings.

Auto tuning procedure

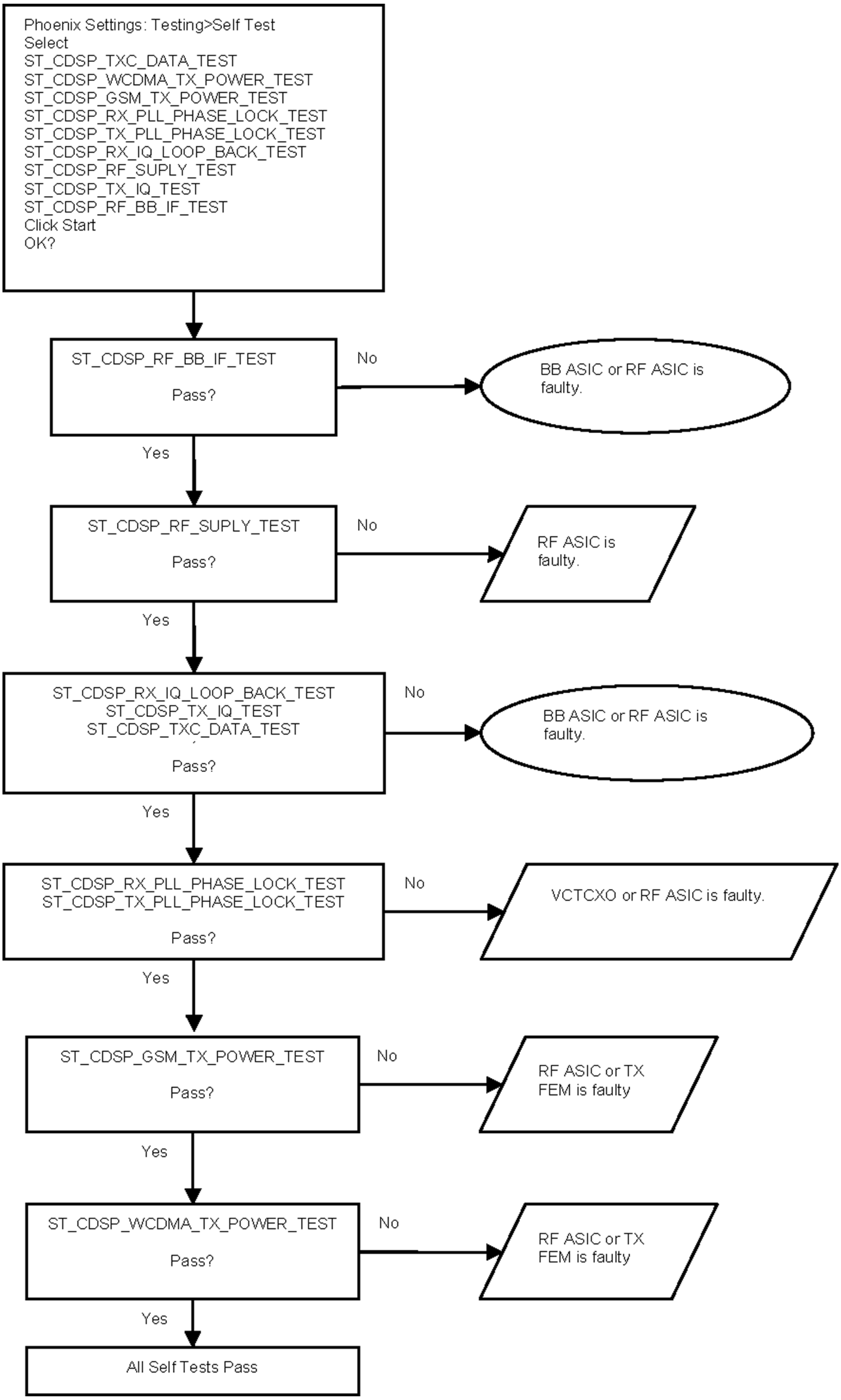
1. Make sure the phone (in the jig) is connected to the equipment. Otherwise some menus will not be shown in Phoenix.
2. To go to autotune, select **Tuning (Alt-U)**→**Auto-Tune (Alt-A)** from the menu.
3. Start autotuning by clicking the *Tune* button.

Self Test Troubleshooting

Self test troubleshooting

Troubleshooting flow

Note: Self tests are recommended to be made when phone is in jig and 50 Ohm load is connected to RF connector. Otherwise powertests may fail depending on antenna load.


Phoenix Settings: Testing>Self Test
Select
ST_CDSP_TXC_DATA_TEST
ST_CDSP_WCDMA_TX_POWER_TEST
ST_CDSP_GSM_TX_POWER_TEST
ST_CDSP_RX_PLL_PHASE_LOCK_TEST
ST_CDSP_TX_PLL_PHASE_LOCK_TEST
ST_CDSP_RX_IQ_LOOP_BACK_TEST
ST_CDSP_RF_SUPLY_TEST
ST_CDSP_TX_IQ_TEST
ST_CDSP_RF_BB_IF_TEST
Click Start
OK?
ST_CDSP_RF_BB_IF_TEST
Pass?
No
BB ASIC or RF ASIC is faulty.
Yes
ST_CDSP_RF_SUPLY_TEST
Pass?
No
RF ASIC is faulty.
Yes
ST_CDSP_RX_IQ_LOOP_BACK_TEST
ST_CDSP_TX_IQ_TEST
ST_CDSP_TXC_DATA_TEST
Pass?
No
BB ASIC or RF ASIC is faulty.
Yes
ST_CDSP_RX_PLL_PHASE_LOCK_TEST
ST_CDSP_TX_PLL_PHASE_LOCK_TEST
Pass?
No
VCTCXO or RF ASIC is faulty.
Yes
ST_CDSP_GSM_TX_POWER_TEST
Pass?
No
RF ASIC or TX FEM is faulty
Yes
ST_CDSP_WCDMA_TX_POWER_TEST
Pass?
No
RF ASIC or TX FEM is faulty
Yes
All Self Tests Pass

Receiver Troubleshooting

Introduction to receiver (RX) troubleshooting

RX can be tested by making a phone call or in local mode. For the local mode testing, use Phoenix service software.

The main RX troubleshooting measurement is RSSI reading. This test measures the signal strength of the received signal. For GSM RSSI measurements, see *GSM RX chain activation for manual measurements/GSM RSSI measurement*. For a similar test in WCDMA mode, see *WCDMA RSSI measurement*.

GSM RX chain activation for manual measurements/GSM RSSI measurement

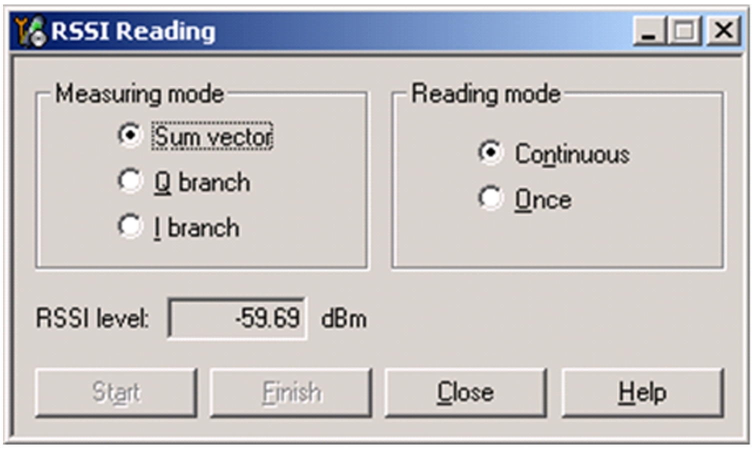
Prerequisites

Make the following settings in Phoenix service software:

Setting	GSM850	GSM900	GSM1800	GSM1900
Phoenix Channel	190	37	700	661
Signal generator to antenna connector	881.66771MHz	942.46771MHz	1842.86771MHz	1960.06771MHz
	(67.71kHz offset)	(67.71kHz offset)	(67.71kHz offset)	(67.71kHz offset)
	at -60dBm	at -60dBm	at -60dBm	at -60dBm

Steps

1. Set the phone to local mode.
2. Activate RSSI reading in Phoenix (**Testing→GSM→RSSI reading**)



RSSI Reading

Measuring mode
● Sum vector
○ Q branch
○ I branch

Reading mode
● Continuous
○ Once

RSSI level: -59.69 dBm

Figure 30 Phoenix GSM RSSI reading window

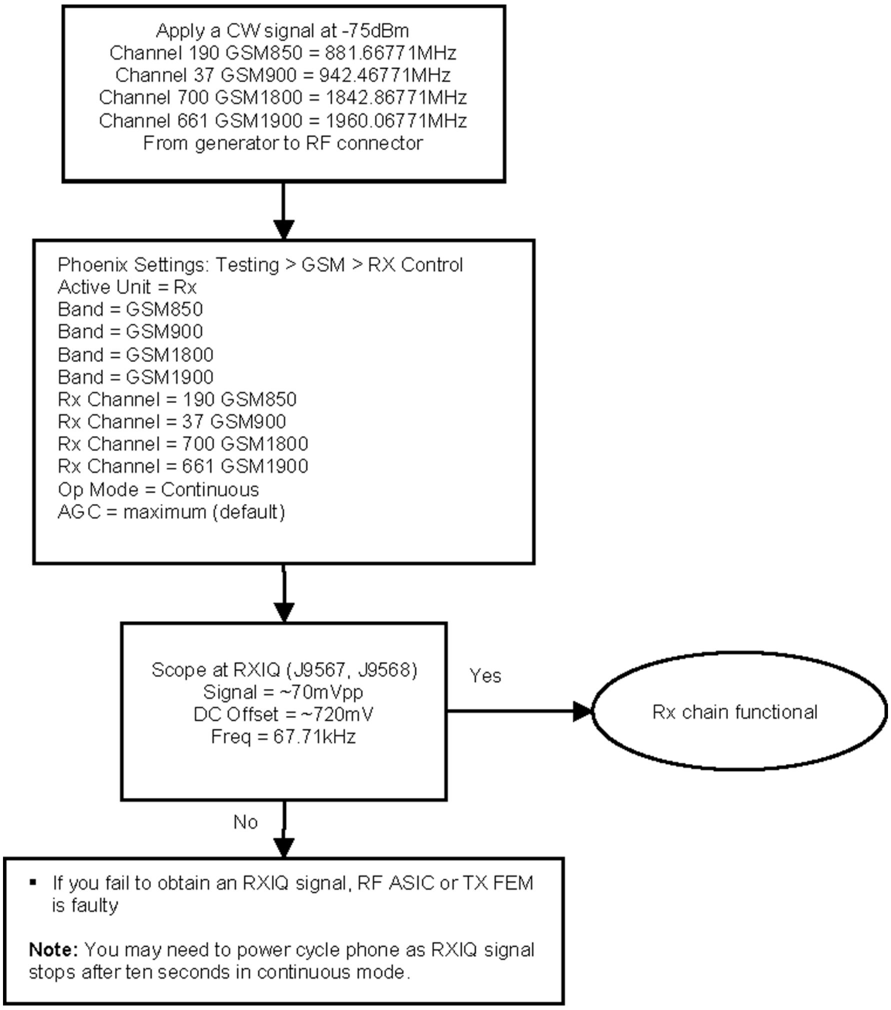
Results

The reading should reflect the level of the signal generator (-losses) +/- 5 dB.

When varying the level in the range -30 to -102 dBm the reading should then follow within +/-5 dB.

GSM receiver troubleshooting flowchart

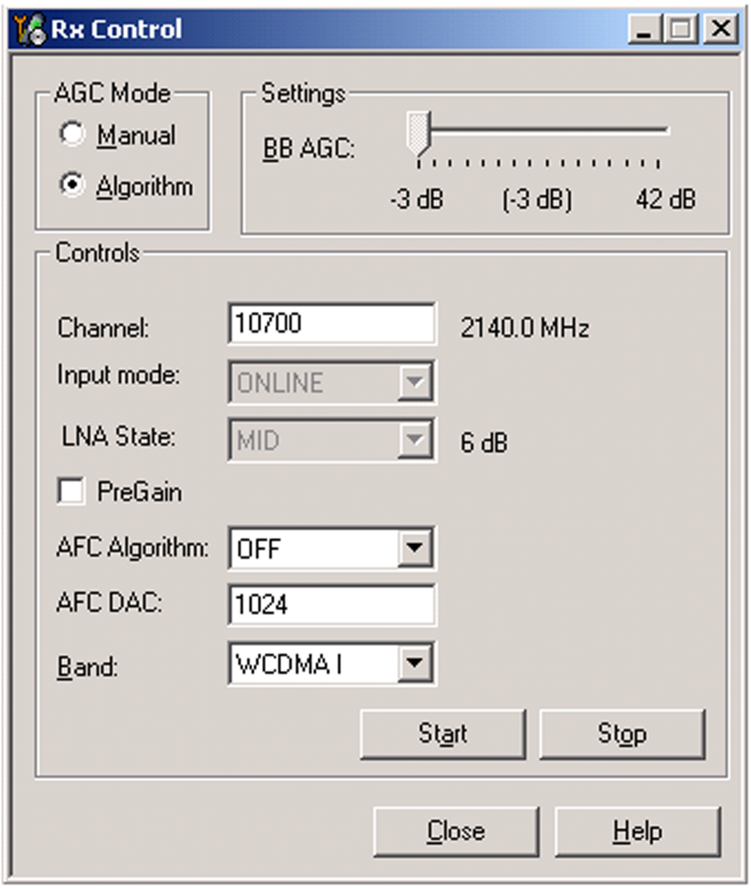
Troubleshooting flow


Apply a CW signal at -75dBm
Channel 190 GSM850 = 881.66771MHz
Channel 37 GSM900 = 942.46771MHz
Channel 700 GSM1800 = 1842.86771MHz
Channel 661 GSM1900 = 1960.06771MHz
From generator to RF connector
Phoenix Settings: Testing > GSM > RX Control
Active Unit = Rx
Band = GSM850
Band = GSM900
Band = GSM1800
Band = GSM1900
Rx Channel = 190 GSM850
Rx Channel = 37 GSM900
Rx Channel = 700 GSM1800
Rx Channel = 661 GSM1900
Op Mode = Continuous
AGC = maximum (default)
Scope at RXIQ (J9567, J9568)
Signal = ~70mVpp
DC Offset = ~720mV
Freq = 67.71kHz
Yes
Rx chain functional
No
If you fail to obtain an RXIQ signal, RF ASIC or TX FEM is faulty
Note: You may need to power cycle phone as RXIQ signal stops after ten seconds in continuous mode.

WCDMA RX chain activation for manual measurement

Steps

1. Via Phoenix Testing menu, choose **WCDMA/RX Control**.
2. In the RX control window, make the following settings:



AGC Mode
○ Manual
● Algorithm

BB AGC: -3 dB (-3 dB) 42 dB

Channel: 10700 2140.0 MHz
Input mode: ONLINE
LNA State: MID 6 dB
☐ PreGain
AFC Algorithm: OFF
AFC DAC: 1024
Band: WCDMA I

Figure 31 Phoenix WCDMA RX Control window

Note: Channel for band WCDMA II 9800, V 4408, VIII 3012

3. Click **Start** to activate the settings.

   If the settings are changed later on (for example, change of channel) you have to click **Stop** and **Start** again.

   Note: Clicking **Stop** also disables TX control if it was active.

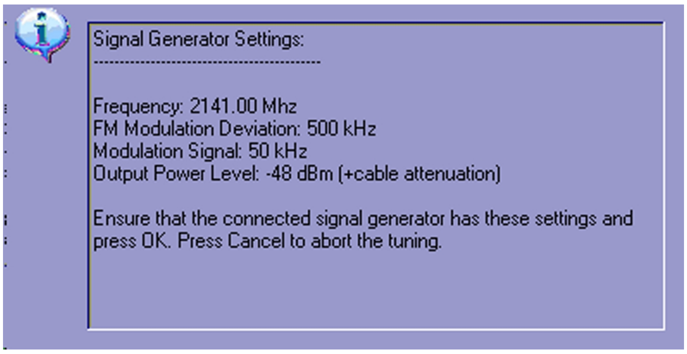
WCDMA RSSI measurement

Prerequisites

WCDMA RX must be activated before RSSI can be measured. For instructions, please refer to WCDMA RX chain activation. Connect signal generator to RF connector and use appropriate frequency for each channel (2141MHz for channel 10700 WCDMA band I, WCDMA modulation).

Steps

1. Set the following RF generator settings:



Signal Generator Settings:

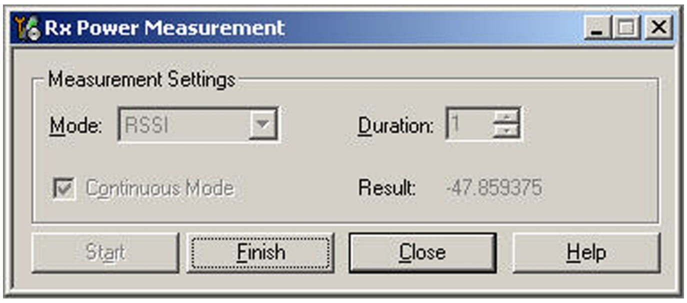
Frequency: 2141.00 Mhz
FM Modulation Deviation: 500 kHz
Modulation Signal: 50 kHz
Output Power Level: -48 dBm (+cable attenuation)

Ensure that the connected signal generator has these settings and press OK. Press Cancel to abort the tuning.

Figure 32 WCDMA RX generator settings

Note: Frequency for band WCDMA II 1961.0MHz, V 882.6MHz, VIII 943.4MHz

2. From the Phoenix testing menu, select **WCDMA→RX Power measurement**
3. In the RX power measurement window, make the following settings:



Rx Power Measurement

Measurement Settings

Mode: RSSI

Duration: 1

☑ Continuous Mode

Result: -47.859375

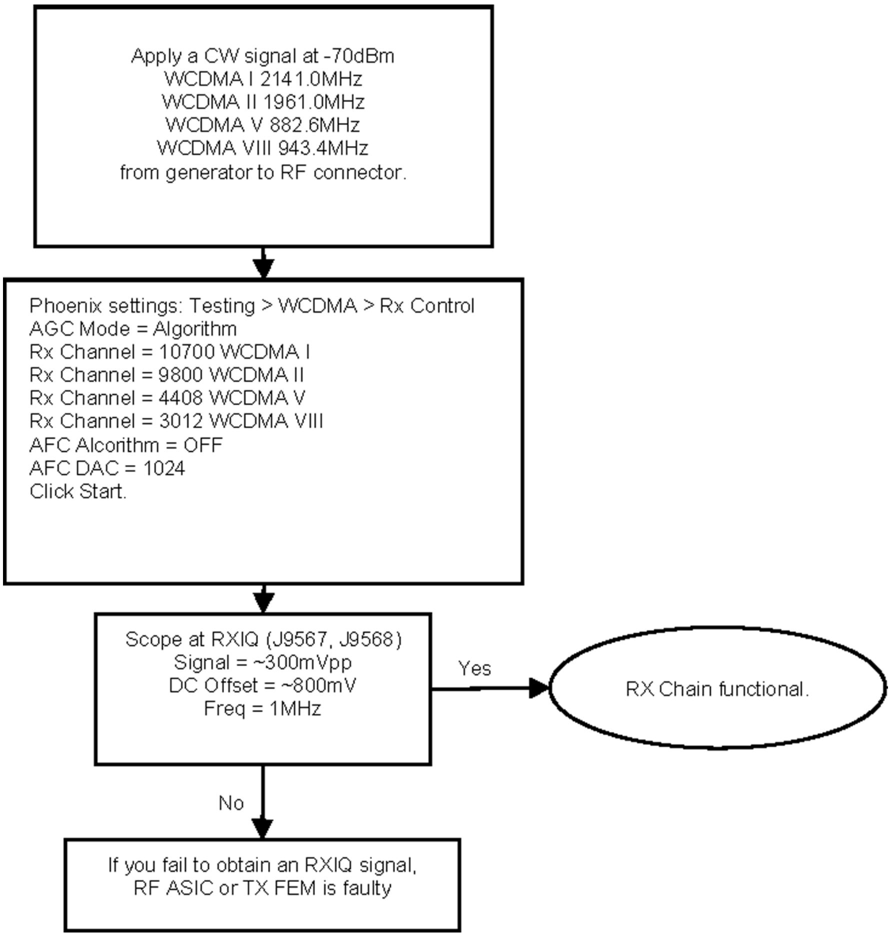
Figure 33 Phoenix WCDMA RX power measurement window

4. Click **Start** to perform the measurement.

   Note: WCDMA RSSI measurement is accurate only with WCDMA modulated signal.

WCDMA receiver troubleshooting flowchart

Troubleshooting flow


Apply a CW signal at -70dBm
WCDMA I 2141.0MHz
WCDMA II 1961.0MHz
WCDMA V 882.6MHz
WCDMA VIII 943.4MHz
from generator to RF connector.
Phoenix settings: Testing > WCDMA > Rx Control
AGC Mode = Algorithm
Rx Channel = 10700 WCDMA I
Rx Channel = 9800 WCDMA II
Rx Channel = 4408 WCDMA V
Rx Channel = 3012 WCDMA VIII
AFC Algorithm = OFF
AFC DAC = 1024
Click Start.
Scope at RXIQ (J9567, J9568)
Signal = ~300mVpp
DC Offset = ~800mV
Freq = 1MHz
Yes
RX Chain functional.
No
If you fail to obtain an RXIQ signal,
RF ASIC or TX FEM is faulty

Transmitter Troubleshooting

General instructions for transmitter (TX) troubleshooting

Please note the following before performing transmitter tests:

- TX troubleshooting requires TX operation.
- Do not transmit on frequencies that are in use.
- The transmitter can be controlled in local mode for diagnostic purposes.
- The most useful Phoenix tool for GSM transmitter testing is “RF Controls”, in WCDMA transmitter testing the best tool is “TX Control”.
- Remember that re-tuning is not a fix! Phones are tuned correctly in production.

Note: Never activate the GSM or WCDMA transmitter without a proper antenna load. Always connect a 50 Ω load to the RF connector (antenna, RF-measurement equipment or at least a 2 W dummy load); otherwise the GSM or WCDMA Power amplifier (PA) may be damaged.

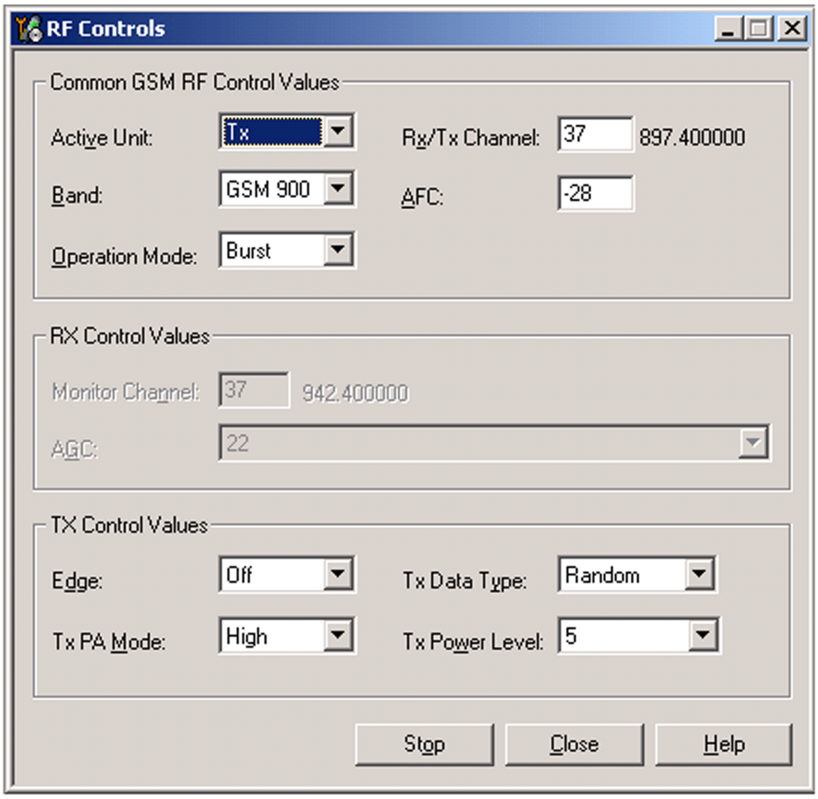
GSM transmitter troubleshooting

Steps

1. Set the phone to local mode.

2. Activate RF controls in Phoenix (**Testing**→**GSM**→**Rf Controls**).

   Make settings as shown in the figure:



RF Controls

Common GSM RF Control Values

Active Unit: Tx

Rx/Tx Channel: 37 897.400000

Band: GSM 900

AFC: -28

Operation Mode: Burst

RX Control Values

Monitor Channel: 37 942.400000

AGC: 22

TX Control Values

Edge: Off

Tx Data Type: Random

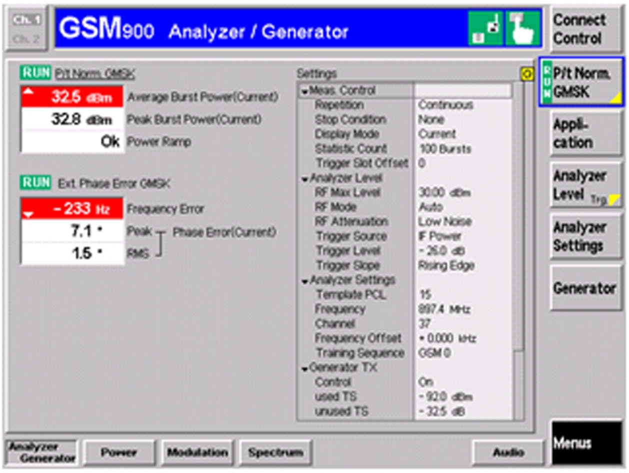
Tx PA Mode: High

Tx Power Level: 5

Figure 34 Phoenix GSM RF controls window

3. Check the basic TX parameters (i.e. power, phase error, modulation and switching spectrum), using a communication analyser (for example CMU200).

Analyser settings


GSM900 Analyzer / Generator
Ch. 1
Ch. 2
Connect Control
P/t Norm. GMSK
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator
Menus
Analyzer Generator
Power
Modulation
Spectrum
Audio

RUN P/t Norm. GMSK

32.5 dBm	Average Burst Power(Current)
32.8 dBm	Peak Burst Power(Current)
Ok	Power Ramp

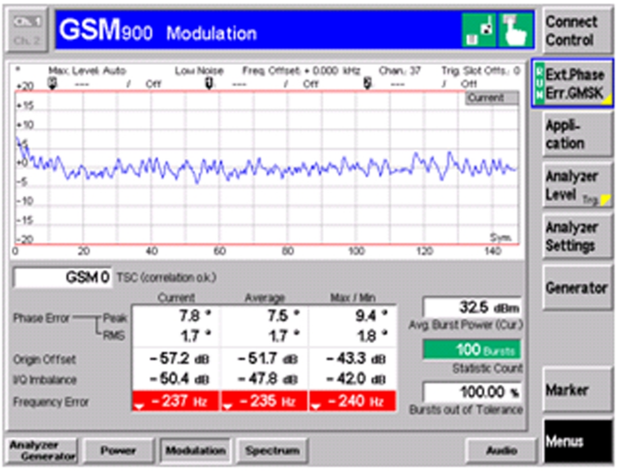
RUN Ext. Phase Error GMSK

- 233 Hz	Frequency Error
7.1 °	Peak – Phase Error(Current)
1.5 °	RMS

Settings

Meas. Control	
Repetition	Continuous
Stop Condition	None
Display Mode	Current
Statistic Count	100 Bursts
Trigger Slot Offset	0
Analyzer Level	
RF Max Level	30.00 dBm
RF Mode	Auto
RF Attenuation	Low Noise
Trigger Source	IF Power
Trigger Level	- 26.0 dB
Trigger Slope	Rising Edge
Analyzer Settings	
Template PCL	15
Frequency	897.4 MHz
Channel	37
Frequency Offset	+ 0.000 kHz
Training Sequence	GSM 0
Generator TX	
Control	On
used TS	- 92.0 dBm
unused TS	- 32.5 dB

Phase error

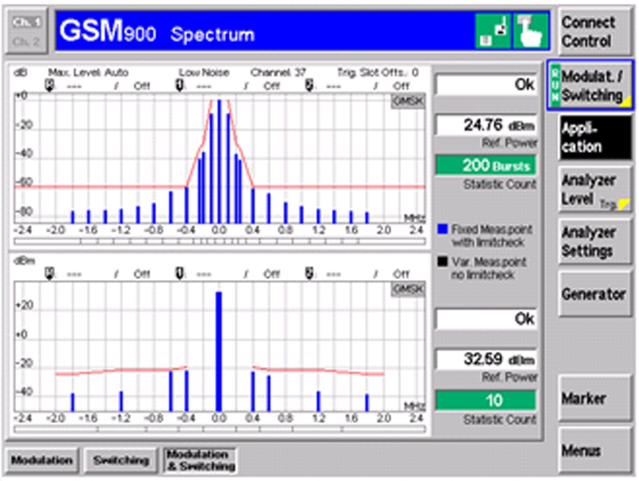

GSM900 Modulation
Max. Level: Auto
Low Noise
Freq. Offset: + 0.000 kHz
Chan.: 37
Trig. Slot Offs.: 0
Off
Current
+20
+15
+10
+5
+0
-5
-10
-15
-20
Sym.
0
20
40
60
80
100
120
140
Connect Control
Ext.Phase Err.GMSK
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator
Marker
Menus
Analyzer Generator
Power
Modulation
Spectrum
Audio

GSM 0 TSC (correlation o.k.)

		Current	Average	Max / Min
Phase Error	Peak	7.8 °	7.5 °	9.4 °
	RMS	1.7 °	1.7 °	1.8 °
Origin Offset		- 57.2 dB	- 51.7 dB	- 43.3 dB
I/Q Imbalance		- 50.4 dB	- 47.8 dB	- 42.0 dB
Frequency Error		- 237 Hz	- 235 Hz	- 240 Hz

32.5 dBm	Avg. Burst Power (Cur.)
100 Bursts	Statistic Count
100.00 %	Bursts out of Tolerance

Modulation/Switching spectrum


GSM900 Spectrum
dB
Max. Level: Auto
Low Noise
Channel: 37
Trig. Slot Offs.: 0
Off
GMSK
+0
-20
-40
-60
-80
dBm
+20
+0
-20
-40
MHz
-2.4
-2.0
-1.6
-1.2
-0.8
-0.4
0.0
0.4
0.8
1.2
1.6
2.0
2.4
Connect Control
Modulat. / Switching
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator
Marker
Menus
Modulation
Switching
Modulation & Switching

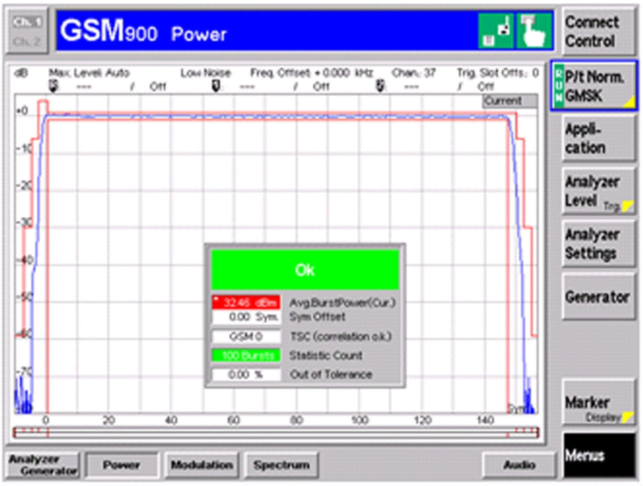
Ok	
24.76 dBm	Ref. Power
200 Bursts	Statistic Count

■ Fixed Meas.point with limitcheck

■ Var. Meas.point no limitcheck

Ok	
32.59 dBm	Ref. Power
10	Statistic Count

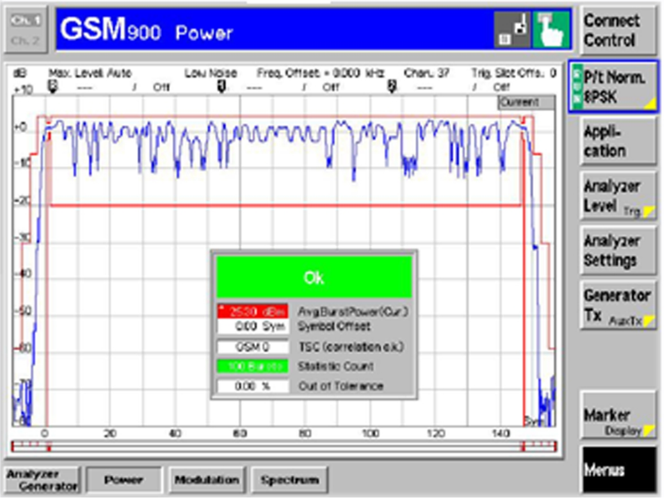
Power/Burst GSM/GPRS (GMSK)


GSM900 Power
dB
Max. Level: Auto
Low Noise
Freq. Offset: + 0.000 kHz
Chan.: 37
Trig. Slot Offs.: 0
Off
Current
+0
-10
-20
-30
-40
-50
-60
-70
0
20
40
60
80
100
120
140
Sym.
Connect Control
P/t Norm. GMSK
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator
Marker Display
Menus
Analyzer Generator
Power
Modulation
Spectrum
Audio

Ok

32.46 dBm	Avg.BurstPower(Cur.)
0.00 Sym.	Sym Offset
GSM 0	TSC (correlation o.k.)
100 Bursts	Statistic Count
0.00 %	Out of Tolerance

Power/Burst - EDGE (8PSK)


GSM900 Power
dB
Max. Level: Auto
Low Noise
Freq. Offset: + 0.000 kHz
Chan.: 37
Trig. Slot Offs.: 0
Off
Current
+10
+0
-10
-20
-30
-40
-50
-60
-70
0
20
40
60
80
100
120
140
Sym.
Connect Control
P/t Norm. 8PSK
Appli-cation
Analyzer Level Trg
Analyzer Settings
Generator Tx AuxTx
Marker Display
Menus
Analyzer Generator
Power
Modulation
Spectrum

Ok

25.50 dBm	AvgBurstPower(Cur.)
0.00 Sym.	Symbol Offset
GSM 0	TSC (correlation o.k.)
100 Bursts	Statistic Count
0.00 %	Out of Tolerance

4. Change power level (RF controls) and make sure the power reading follows accordingly.

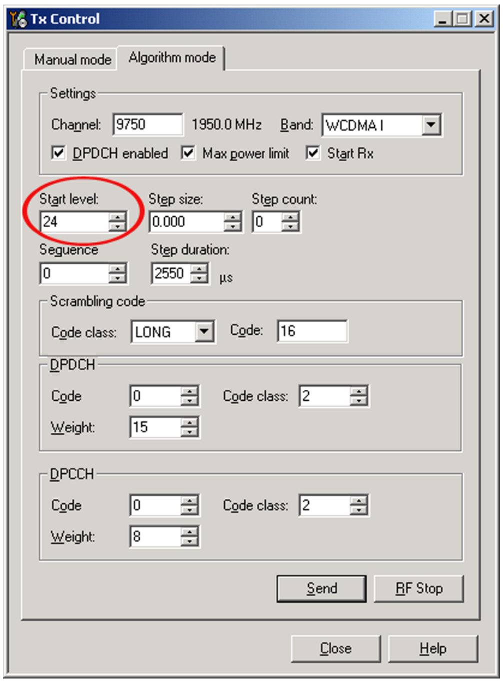
Next actions

If you want to troubleshoot the other bands, change band with RF controls and set the communication analyser accordingly.

WCDMA transmitter troubleshooting

Steps

1. Set the phone to local mode.
2. In Phoenix, select **Testing→WCDMA→TX control** .
3. In the TX control window, make settings as in the picture:



Settings
Channel: 9750 1950.0 MHz Band: WCDMA I
☑ DPDCH enabled ☑ Max power limit ☑ Start Rx

Start level: 24
Step size: 0.000
Step count: 0
Sequence: 0
Step duration: 2550 µs

Scrambling code
Code class: LONG Code: 16

DPDCH
Code 0 Code class: 2
Weight: 15

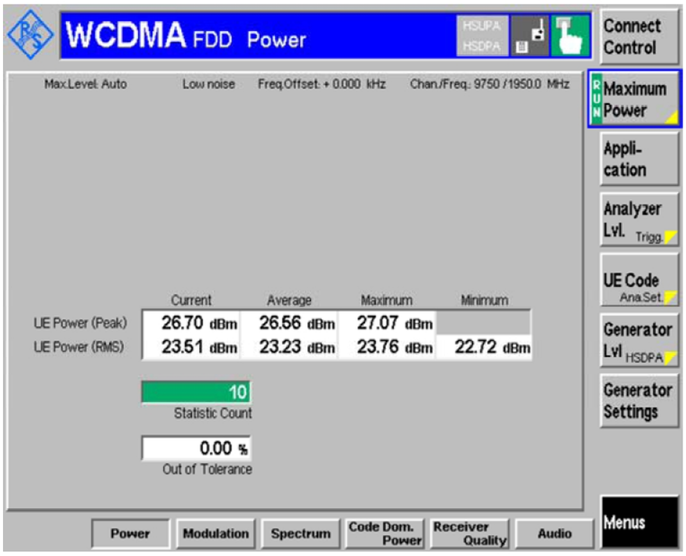
DPCCH
Code 0 Code class: 2
Weight: 8

Note: For WCDMA TX channels: band V 4183, VIII 2787

4. Click **Send** to enable the settings and activate TX.

   If settings are changed (eg. new channel), you have to click **RF Stop** and **Send** again.
5. Check the basic TX parameters using a communication analyzer (for example CMU200).

Power


WCDMA FDD Power
HSUPA
HSDPA
Connect Control
RUN
Maximum Power
Appli-cation
Analyzer Lvl. Trigg.
UE Code Ana.Set.
Generator Lvl HSDPA
Generator Settings
Menus
Power
Modulation
Spectrum
Code Dom. Power
Receiver Quality
Audio

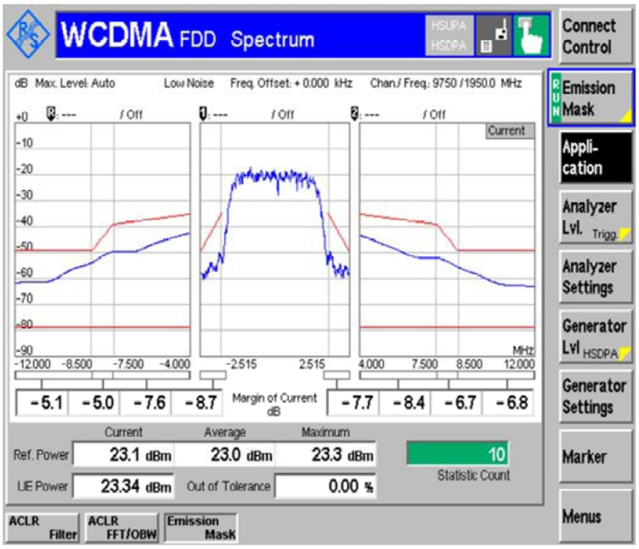
Max.Level: Auto Low noise Freq.Offset: + 0.000 kHz Chan./Freq.: 9750 / 1950.0 MHz

	Current	Average	Maximum	Minimum
UE Power (Peak)	26.70 dBm	26.56 dBm	27.07 dBm	
UE Power (RMS)	23.51 dBm	23.23 dBm	23.76 dBm	22.72 dBm

Statistic Count: 10

Out of Tolerance: 0.00 %

Spectrum - Emission Mask


WCDMA FDD Spectrum
HSUPA
HSDPA
Connect Control
RUN
Emission Mask
Appli-cation
Analyzer Lvl. Trigg.
Analyzer Settings
Generator Lvl HSDPA
Generator Settings
Marker
Menus
ACLR Filter
ACLR FFT/OBW
Emission Mask
dB
+0
-10
-20
-30
-40
-50
-60
-70
-80
-90
R: --- / Off
1: --- / Off
2: --- / Off
Current
MHz
-12.000
-8.500
-7.500
-4.000
-2.515
2.515
4.000
7.500
8.500
12.000

Max. Level: Auto Low Noise Freq. Offset: + 0.000 kHz Chan./ Freq.: 9750 / 1950.0 MHz

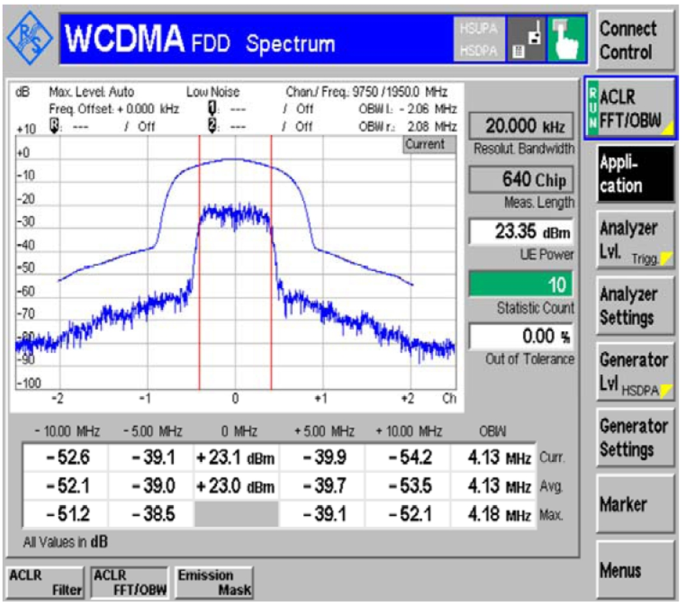
Margin of Current dB: -5.1 -5.0 -7.6 -8.7 | -7.7 -8.4 -6.7 -6.8

	Current	Average	Maximum
Ref. Power	23.1 dBm	23.0 dBm	23.3 dBm

UE Power: 23.34 dBm Out of Tolerance: 0.00 %

Statistic Count: 10

Spectrum - ACLR (FFT/OBW)


WCDMA FDD Spectrum
HSUPA
HSDPA
Connect Control
RUN
ACLR FFT/OBW
Appli-cation
Analyzer Lvl. Trigg.
Analyzer Settings
Generator Lvl HSDPA
Generator Settings
Marker
Menus
ACLR Filter
ACLR FFT/OBW
Emission Mask
dB
+10
+0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-2
-1
0
+1
+2
Ch
Current

Max. Level: Auto Low Noise Chan./ Freq.: 9750 / 1950.0 MHz
Freq. Offset: + 0.000 kHz 1: --- / Off OBW l.: - 2.06 MHz
R: --- / Off 2: --- / Off OBW r.: 2.08 MHz

Resolut. Bandwidth: 20.000 kHz

Meas. Length: 640 Chip

UE Power: 23.35 dBm

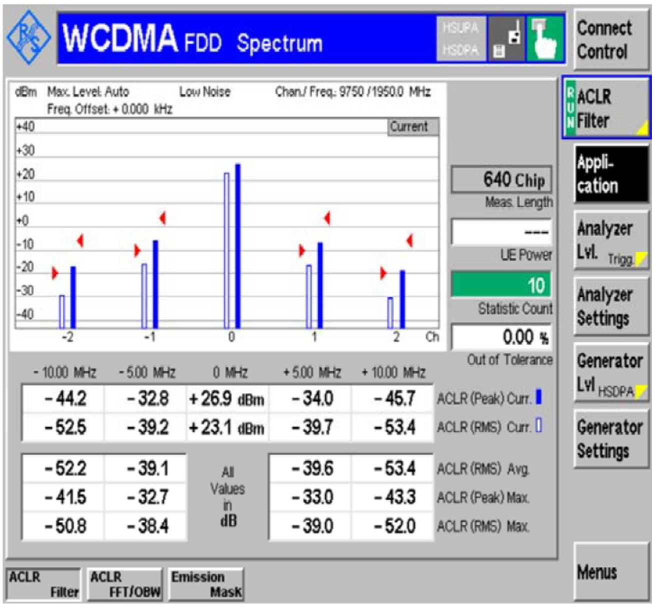
Statistic Count: 10

Out of Tolerance: 0.00 %

- 10.00 MHz	- 5.00 MHz	0 MHz	+ 5.00 MHz	+ 10.00 MHz	OBW	
-52.6	-39.1	+23.1 dBm	-39.9	-54.2	4.13 MHz	Curr.
-52.1	-39.0	+23.0 dBm	-39.7	-53.5	4.13 MHz	Avg.
-51.2	-38.5		-39.1	-52.1	4.18 MHz	Max.

All Values in dB

Spectrum - ACLR (Filter)


WCDMA FDD Spectrum
HSUPA
HSDPA
Connect Control
RUN
ACLR Filter
Appli-cation
Analyzer Lvl. Trigg.
Analyzer Settings
Generator Lvl HSDPA
Generator Settings
Menus
ACLR Filter
ACLR FFT/OBW
Emission Mask
dBm
+40
+30
+20
+10
+0
-10
-20
-30
-40
-2
-1
0
1
2
Ch
Current

Max. Level: Auto Low Noise Chan./ Freq.: 9750 / 1950.0 MHz
Freq. Offset: + 0.000 kHz

Meas. Length: 640 Chip

UE Power: ---

Statistic Count: 10

Out of Tolerance: 0.00 %

- 10.00 MHz	- 5.00 MHz	0 MHz	+ 5.00 MHz	+ 10.00 MHz	
-44.2	-32.8	+26.9 dBm	-34.0	-45.7	ACLR (Peak) Curr. ▮
-52.5	-39.2	+23.1 dBm	-39.7	-53.4	ACLR (RMS) Curr. ▯
-52.2	-39.1	All Values in dB	-39.6	-53.4	ACLR (RMS) Avg.
-41.5	-32.7		-33.0	-43.3	ACLR (Peak) Max.
-50.8	-38.4		-39.0	-52.0	ACLR (RMS) Max.

Next actions

If you want to troubleshoot the other bands, change band with RF controls and set the communication analyser accordingly.

■ Antenna Troubleshooting

Antenna troubleshooting

Antenna contacts, visual check

In the main antenna there is one feed and two GND contacts. Check that GND and feed pads take proper contact to the C-clips on main PWB.

Antenna matching components, visual check

There are four matching components on the antenna flex. Check visually that all components are properly soldered on the flex. In the case damage you need to replace the whole antenna.

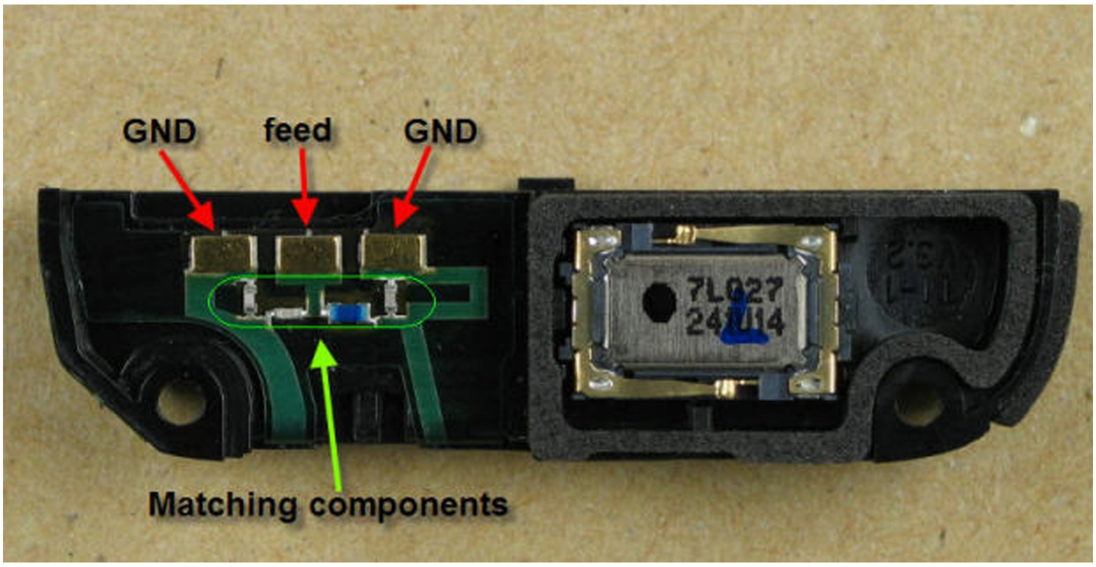

GND
feed
GND
7L027
24U14
Matching components

Figure 35 Antenna contacts and matching components

5 — Camera Module Troubleshooting

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Table of Contents

Introduction to camera module troubleshooting 5–5
The effect of image taking conditions on image quality 5–6
Image quality analysis 5–10
    Possible faults in image quality.................... 5–10
    Testing for dust in camera module 5–11
    Testing camera image sharpness.................... 5–12
    Effects of dirty or defective camera lens protection window.................... 5–13
    Faulty pixels in images 5–14
    Flash photography problems.................... 5–15
Main (back) camera troubleshooting flowcharts.................... 5–16
    Main camera troubleshooting.................... 5–16
    Main camera baseband troubleshooting.................... 5–16
    Main camera baseband troubleshooting - powerings 5–18
    No recognizable viewfinder image 5–19
    Bad image quality troubleshooting 5–20
    Flash troubleshooting.................... 5–21
Secondary (front) camera troubleshooting flow 5–22
Accelerometer troubleshooting.................... 5–23

List of Figures

Figure 36 Only center part of image is in focus due to limited depth of focus 5–6
Figure 37 Blurring caused by shaking hands 5–7
Figure 38 Near objects get skewed when taking images from a moving vehicle....................5–7
Figure 39 Noisy image taken in +70 degrees Celsius 5–8
Figure 40 Image taken against light....................5–8
Figure 41 Flicker in an image; object illuminated by strong fluorescent light....................5–9
Figure 42 A lens reflection effect caused by sunshine....................5–9
Figure 43 Good image taken indoors.................... 5–10
Figure 44 Good image taken outdoors 5–10
Figure 45 Effects of dust on optical path 5–11
Figure 46 Image taken with clear protection window 5–13
Figure 47 Image taken with greasy protection window 5–13
Figure 48 Image of point light sources taken with a clean protective window.................... 5–14
Figure 49 Image of point light sources taken with a dirty (finger print) protective window 5–14
Figure 50 Enlargement of a hot pixel.................... 5–15
Figure 51 Light from the flash has reflected on particles in front of the camera 5–15

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Introduction to camera module troubleshooting

Background, tools and terminology

Faults or complaints in camera operation can be roughly categorised into three subgroups:

1. Camera is not functional at all; no image can be taken.
2. Images can be taken but there is nothing recognizable in them.
3. Images can be taken and they are recognizable but for some reason the quality of images is seriously degraded, or customer complains about image quality.

Image quality is very hard to measure quantitatively, and even comparative measurements are difficult (comparing two images) to do, if the difference is small. Especially if the user is not satisfied with his/her device's image quality, and tells, for example, that the images are not sharp, it is fairly difficult to accurately test the device and get an exact figure which would tell whether the device is functioning properly.

Often subjective evaluation has to be used for finding out if a certain property of the camera is acceptable or not. Some training or experience of a correctly operating reference device may be needed in order to detect what actually is wrong, or is there anything wrong at all.

It is easy for the user to take bad images in bad conditions. Therefore the camera operation has to be checked always in constant conditions (lighting, temperature) or by using a second, known-to-be good device as reference. Experience helps significantly in analysing image quality.

Terms

Autofocus	Camera module contains lens movement mechanics for focus adjustment. Autofocus enables camera to take sharp images of objects positioned between 10cm to infinity. During AF the viewfinder image will be momentarily blurred as the camera searches for the right focus setting.
Digital zoom	Digital zoom is done by first cropping the image by the zoom ratio and then upscaling it to the output resolution. This will decrease the image quality especially with high zoom ratios.
Dynamic range	Camera's ability to capture details in dark and bright areas of the scene simultaneously.
Exposure time	Camera modules use silicon sensor to collect light and for forming an image. The imaging process roughly corresponds to traditional film photography, in which exposure time means the time during which the film is exposed to light coming through optics. Increasing the time will allow for more light hitting the film and thus results in brighter image. The operation principle is exactly the same with silicon sensor, but the shutter functionality is handled electronically i.e. there is no mechanical moving parts like in film cameras.
Flicker	Phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in an image.
ND-filter	Neutral density filter is a filter which is used in very bright conditions to reduce the amount of light hitting the sensor. The filter is built into the camera module and applied automatically when needed.
Noise	Variation of response between pixels with same level of input illumination.
Resolution	Usually the amount of pixels in the camera sensor. In some occasions the term resolution is used for describing the sharpness of the images.

Sensitivity	Camera module's sensitivity to light. In equivalent illumination conditions, a less sensitive camera needs a longer exposure time to gather enough light in forming a good image. Analogous to ISO speed in photographic film.
Sharpness	Good quality images are 'sharp' or 'crisp', meaning that image details are well visible in the picture. However, certain issues, such as non-idealities in optics, cause image blurring, making objects in picture to appear 'soft'. Each camera type typically has its own level of performance.
Shutter	The electronic shutter is used when short exposure times are needed and in video. When the mechanical shutter is used a black sheet will cover the lens after the exposure.

The effect of image taking conditions on image quality

There are some factors, which may cause poor image quality, if not taken into account by the end user when shooting images, and thus may result in complaints. The items listed are normal to camera operation and are not a reason for changing the camera module.

Autofocus

When the camera is focusing a lens is moved inside the module to give the sharpest possible image. This camera module is specified to operate satisfactorily from 10 cm to infinite distance of scene objects. Trying to photograph objects closer than 10 cm is likely to result in a blurred out of focus image. The lack of sharpness is first visible in full resolution images. Images taken very close to the subject, a limited depth of focus will be visible, that is the upper or lower parts of the image may be out of focus. This is normal; do not change the camera module.

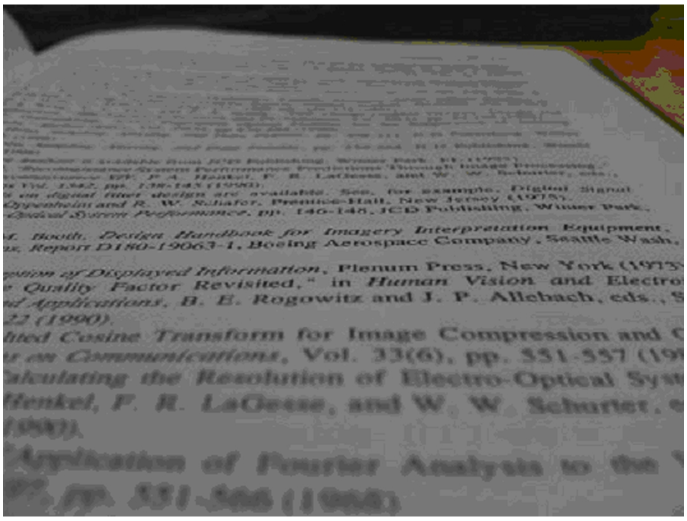


Figure 36 Only center part of image is in focus due to limited depth of focus

The amount of light available

In dim conditions camera runs out of sensitivity. The exposure time is long (especially in the night mode) and the risk of getting shaken (= blurred) images increases. In addition, image noise level grows. The maximum exposure time in the night mode is ¼ seconds. Therefore, images need to be taken with extreme care and by supporting the phone when the amount of light reflected from the target is low. Because of the longer exposure time and larger gain value, noise level increases in low light conditions. Sometimes blurring may even occur in daytime, if the image is taken very carelessly. See the figure below for an example. This is normal; do not change the camera module.

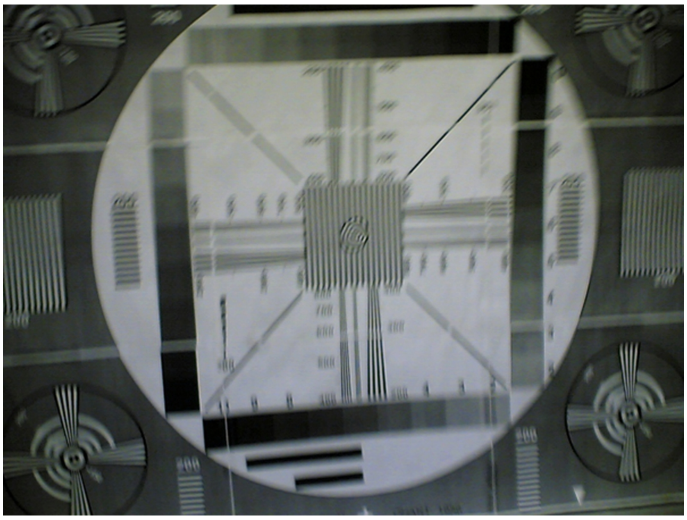


Figure 37 Blurring caused by shaking hands

Movement in bright light

If an image is taken of moving objects or if the device is used in a moving vehicle, object 'skewing' or 'tilting' may occur. This phenomenon is fundamental to most CMOS camera types, and may happen when using the electronic shutter. The movement of camera or object sometimes cause blurring indoors or in dim lighting conditions because of long exposure time. This is normal; do not change the camera module.

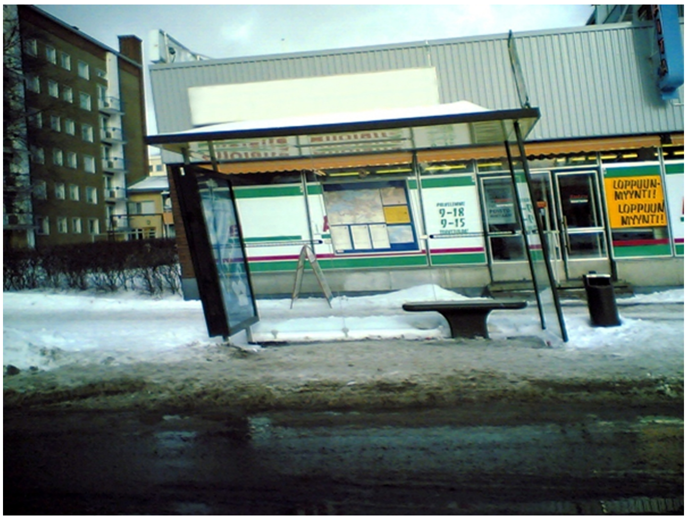


Figure 38 Near objects get skewed when taking images from a moving vehicle

Temperature

High temperatures inside the mobile phone cause more noise to appear in images. For example, in +70 degrees (Celsius), the noise level may be very high, and it further grows if the conditions are dim. If the phone processor has been heavily loaded for a long time before taking an image, the phone might have considerably higher temperature inside than in the surrounding environment. This is also normal to camera operation; do not change the camera module.

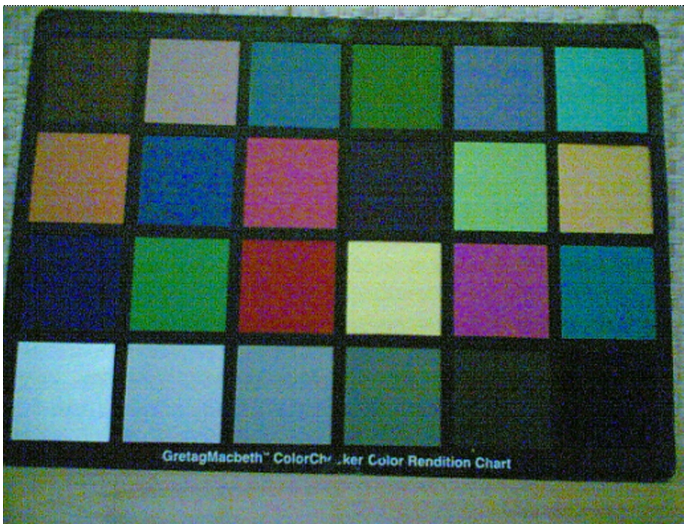


Figure 39 Noisy image taken in +70 degrees Celsius

Phone display

If the display contrast is set too dark, the image quality degrades: the images may be very dark depending on the setting. If the display contrast is set too bright, image contrast appears bad and "faint". This problem is solved by setting the display contrast correctly. This is normal behaviour; do not change the camera module.

Basic rules of photography (especially shooting against light)

Because of dynamic range limitations, taking images against bright light might cause either saturated image or the actual target appear too dark. In practice, this means that when taking an image indoors and having, for example, a window behind the object, the result is usually poor. This is normal behaviour; do not change the camera module.

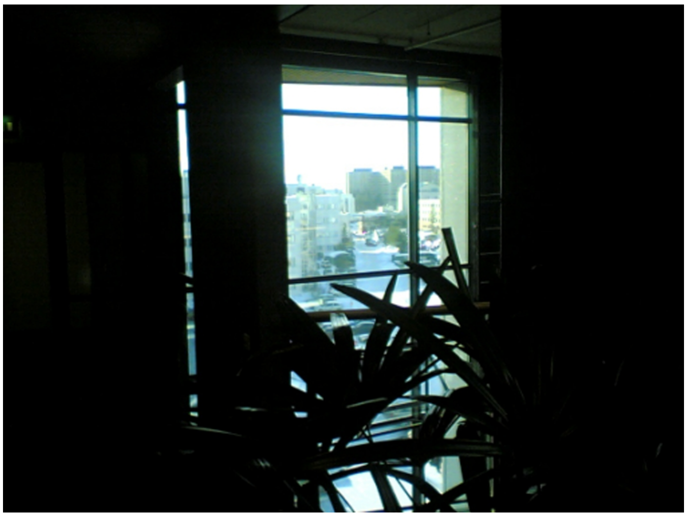


Figure 40 Image taken against light

Flicker

In some occasions a bright fluorescent light may cause flicker in the viewfinder and captured image. This phenomenon may also be a result, if images are taken indoors under the mismatch of 50/60 Hz electricity network frequency. The electricity frequency used is automatically detected by the camera module. In some very few countries, both 50 and 60 Hz networks are present and thus probability for the phenomenon increases. Flickering occurs also under high artificial illumination level. Flickering only occurs when the rolling shutter is used. This is normal behaviour; do not change the camera module.

Figure 41 Flicker in an image; object illuminated by strong fluorescent light

Bright light outside of image view

Especially the sun can cause clearly visible lens glare phenomenon and poor contrast in images. This happens because of undesired reflections inside the camera optics. Generally this kind of reflections are common in all optical systems. This is normal behaviour; do not change the camera module.

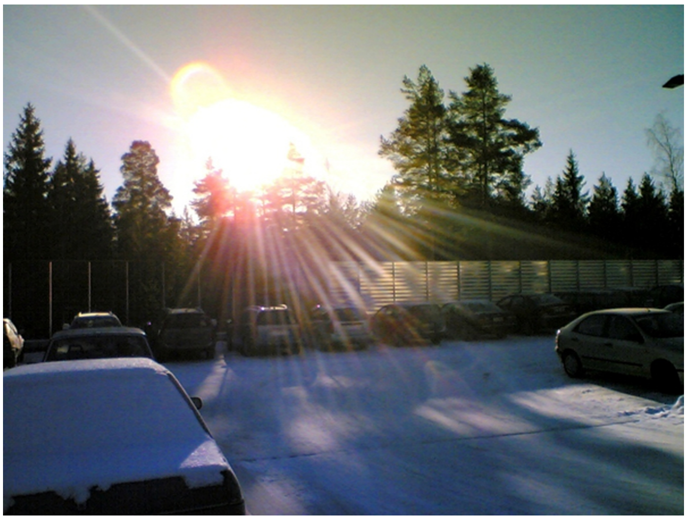


Figure 42 A lens reflection effect caused by sunshine

Examples of good quality images

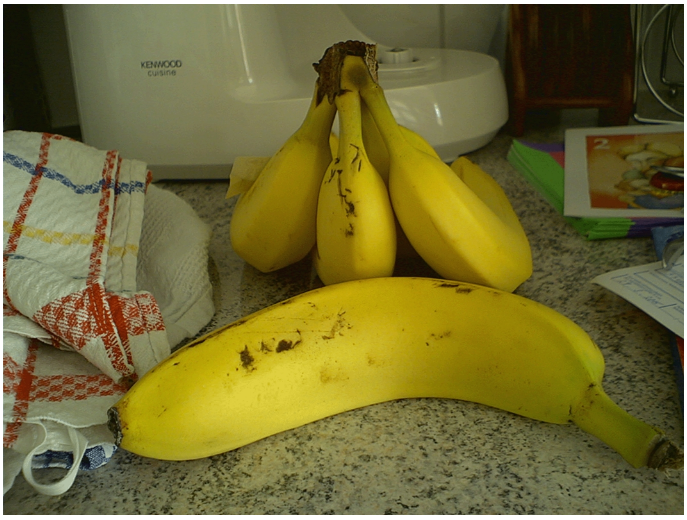


Figure 43 Good image taken indoors

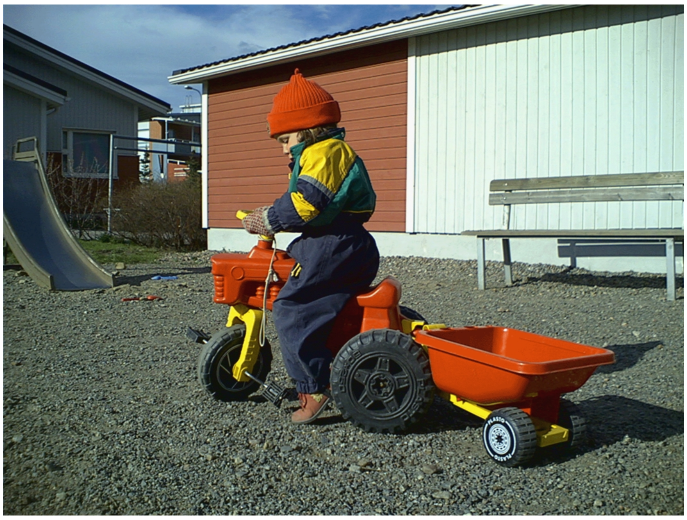


Figure 44 Good image taken outdoors

Image quality analysis

Possible faults in image quality

When checking for possible errors in camera functionality, knowing what error is suspected significantly helps the testing by narrowing down the amount of test cases. The following types of image quality problems may be expected to appear:

- Dust (black spots)
- Lack of sharpness
- Bit errors

In addition, there are many other kinds of possibilities for bad image quality, but those are ruled out from the scope of this document since the probability of their appearance is small.

Testing for dust in camera module

Symptoms and diagnosis

For detecting these kinds of problems, take an image of a uniform white surface and analyse it in full resolution. A good quality PC monitor is preferred for analysis. Search carefully, since finding these defects is not always easy. Figure "Effects of dust on optical path" is an example image containing easily detectable dust problems.

When taking a white image, use uniformly lightened white paper or white wall. One possibility is to use uniform light but in this case make sure that the camera image is not flickering when taking the test image. In case flickering happens, try to reduce illumination level. Use JPEG image format for analysing, and set the image quality parameter to ‘High Quality’.

Black spots in an image are caused by dirt particles trapped inside the optical system. Clearly visible and sharp edged black dots in an image are typically dust particles on the image sensor. These spots are searched for in the manufacturing phase, but it is possible that the camera body cavity contains a particle, which may move onto the image sensor active surface, for example, when the phone is dropped. Thus it is also possible that the problem will disappear before the phone is brought to service. The camera should be replaced if the problem is present when the service technician analyses the phone.

If a dust particle is lying on the infrared filter surface on either side, they are hard to locate because they are out of focus, and appear in the image as large, grayish and fading-edge 'blobs'. Sometimes they are invisible to the eye, and thus the user probably does not notice them at all. However, it is possible that a larger particle disturbs the user, causing need for service.

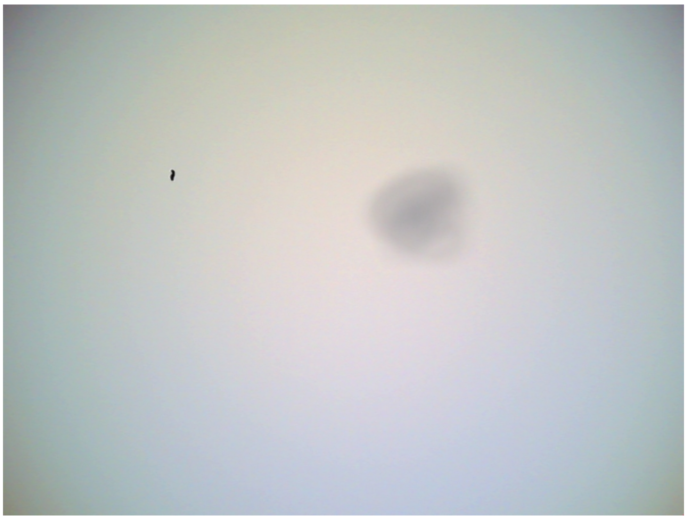


Figure 45 Effects of dust on optical path

If large dust particles get trapped on top of the lens surface in the cavity between camera window and lens, they will cause image blurring and poor contrast. The dust gasket between the window and lens should prevent any particles from getting into the cavity after the manufacturing phase.

If dust particles are found on the sensor, this is classified as a manufacturing error of the module and the camera should be replaced. Any particles inside the cavity between the protection window and lens have most probably been trapped there in the assembly phase at a Nokia factory. Unauthorized disassembling of the product can also be the root of the problem. However, in most cases it should be possible to remove the particle(s) by using clean compressed air. Never wipe the lens surface before trying compressed air; the possibility of damaging the lens is substantial. Always check the image sharpness after removing dust.

Testing camera image sharpness

Symptoms and diagnosis

If pictures taken with a device are claimed to be blurry, there are five possible sources for the problem:

1. The protection window is fingerprinted, soiled, dirty, visibly scratched or broken.
2. The camera module has failed to focus correctly, producing a blurred image.
3. User has tried to take pictures in too dark conditions and images are blurred due to handshake or movement. This is not a cause to replace camera module.
4. There is dirt between the protection window and the camera lens.
5. The protection window is defective. This can be either a manufacturing failure or caused by the user. The window should be changed.

A quantitative analysis of sharpness is very difficult to conduct in any other environment than optics laboratory. Therefore, subjective analysis should be used.

If no visible defects (items 1-4) are found, a couple of test images should be taken. Generally, a well-illuminated typical indoor scene, such as the one in Figure "Good image taken indoors", can be used as a target. The main considerations are:

- The camera module has to be given time to focus correctly. Correct focusing is normally indicated with a flashing icon or green bracket in the viewfinder. During focusing, the image in the viewfinder moves slightly back and fourth, this is normal and shows that the lens unit is moving. During the movement a faint sound can be heard from the camera head.
- The protection window has to be clean.
- The amount of light (300 – 600 lux (bright office lighting)) is sufficient.
- The scene should contain, for example, small objects for checking sharpness. Their distance should be 1 – 2 meters.
- If possible, compare the image to another image of the same scene, taken with a different device. Note that the reference device has to be a similar Nokia phone.

There are several conditions in which AF operation is challenging for the camera module, i.e. failing from time to time. These include:

- Low light scenes and night mode
- Scenes with low contrast
- Fast-moving objects

AF operation is disabled on purpose in “night”, “landscape”, “sports”, and “video” modes. When using these modes the lens is set to a predetermined focal position and isn’t moved during use.

Under low light and night mode the AF function is slower than under good light, it may even fail to find correct focus position. Low contrast scenes or fast moving objects may also slow down or cause AF to fail. This is normal operation, and is not a cause to replace camera.

The operation of AF can be tested by taking images of objects at different distances. Good distances are 20 cm, 60 cm and infinity (>3 m). Any LED or xenon flashes should not be used while taking the images.

The taken images should be analysed on PC screen at 100% scaling simultaneously with a reference image. Pay attention to the computer display settings; at least 65000 colors (16 bit) have to be used. 256 (8-bit) color setting is not sufficient; true color (24 bit, 16 million colors) or 32 bit (full color) setting is recommended.

If the differences are noticeable at a glance and also if the one under investigation is significantly inferior, the module might have a faulty lens. In this case, the module should be changed. Always recheck the resolution after changing the camera module. If a different module produces a clearly noticeable quality gap, the fault is probably in the camera window. Check the window by looking carefully through it when replacing the module. As references Figure "Good image taken indoors" and Figure "Good image taken outdoors" can be used. Another possibility is to use a service point comparison phone, if available.

Effects of dirty or defective camera lens protection window

The following series of images demonstrates the effects of fingerprints on the camera protection window.

> **Note:** The effects of any dirt in images can vary very much; it may be difficult to judge if the window has been dirty when some image has been taken or if something else has been wrong. That is why the cleanness of the protection window should always be checked and the window should be wiped clean with a suitable cloth.

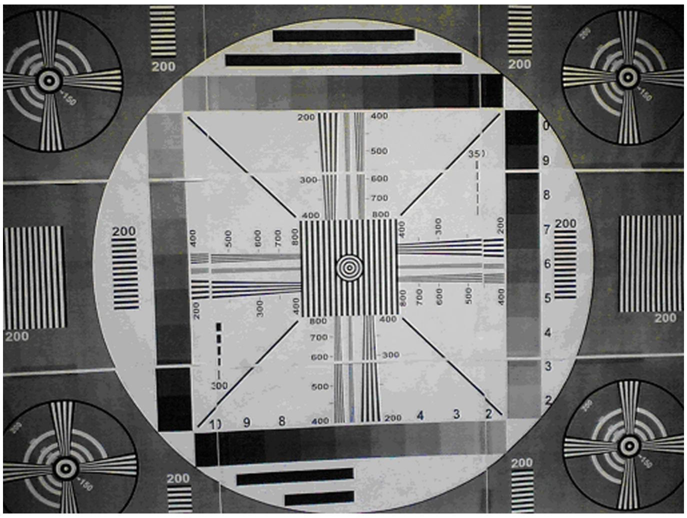


Figure 46 Image taken with clear protection window

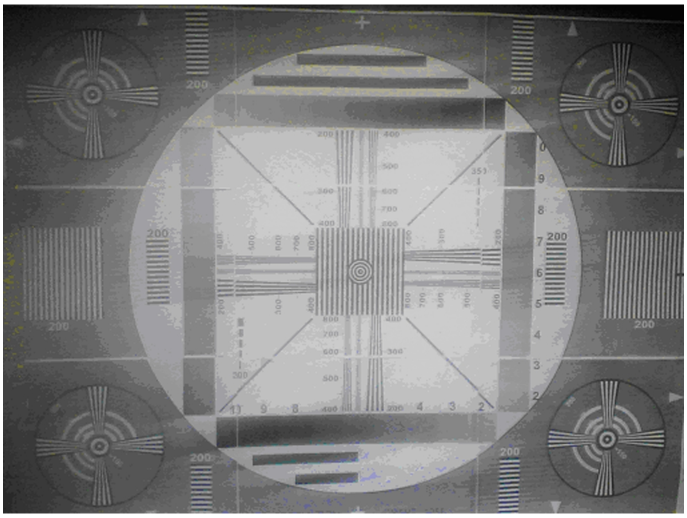


Figure 47 Image taken with greasy protection window

Bright point light sources might cause images that have flares around the light source if the protection window is dirty. A smeared fingerprint may be hard to see on the protective window but if will affect the image quality. These flares can be avoided by cleaning the window with a suitable cloth.

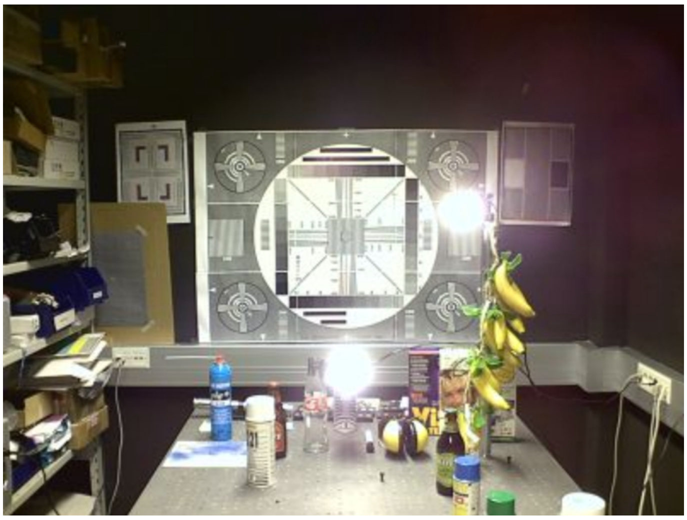


Figure 48 Image of point light sources taken with a clean protective window

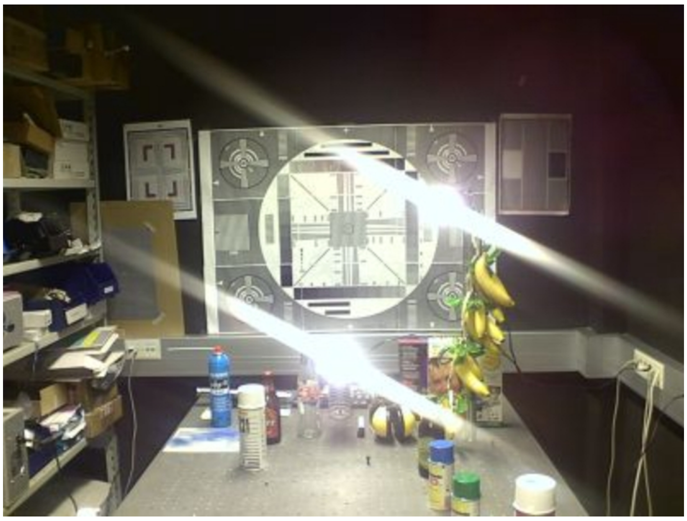


Figure 49 Image of point light sources taken with a dirty (finger print) protective window

Faulty pixels in images

Faulty pixels are pixels that do not respond to light in the same way as the pixels around them. There are three main types of faulty pixels, dead, stuck and hot pixels.

Dead pixels are always black or significantly darker than their surrounding. Dead pixels appear as black spots in all lightning conditions. Camera modules producing images with dead pixels that are clearly noticeable should be replaced.

If the pixel remains always saturated to its maximum value it is stuck. Stuck pixels may appear as red, green, blue or white spots in all lightning conditions. Camera modules producing images with one or more stuck pixels should be replaced.

Hot pixels are pixels that easily saturate in dim light conditions. It is normal to get a lot of noise and hot pixels in night conditions or otherwise dark conditions. The hot pixels should disappear when the ambient light is increased, but may still appear in darker areas of an otherwise well illuminated scene.

When examining an image for defect pixels, test images should be viewed as 100% enlargements on a PC monitor.

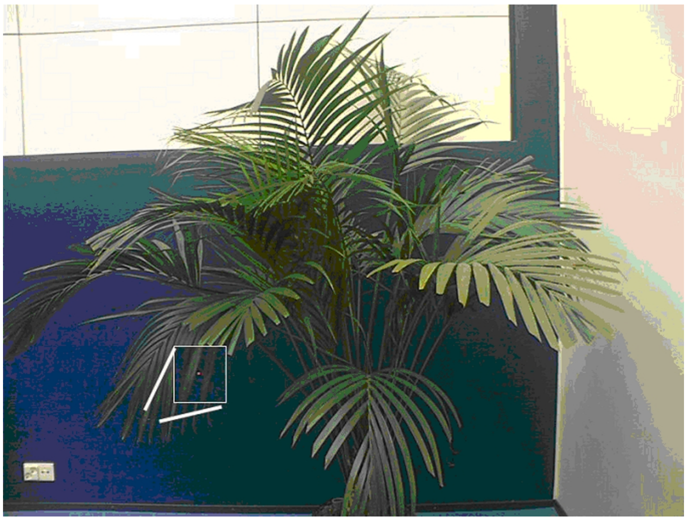


Figure 50 Enlargement of a hot pixel

Flash photography problems

Use of flash device may affect the image in many ways.

- White balance errors. The image may get a wrong tone due to mixing of flash colour temperature and ambient lightning. This is unwanted but normal feature.
- Dust reflections. Dust or water drops in front of the flash unit may reflect strongly to the camera sensor. See the following figure.

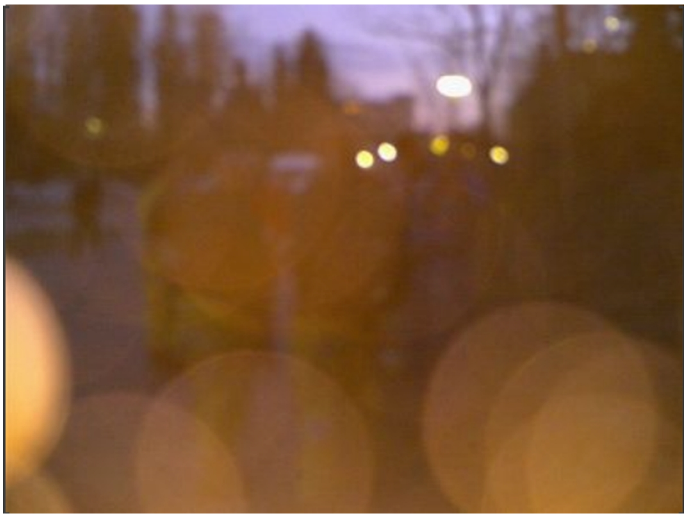
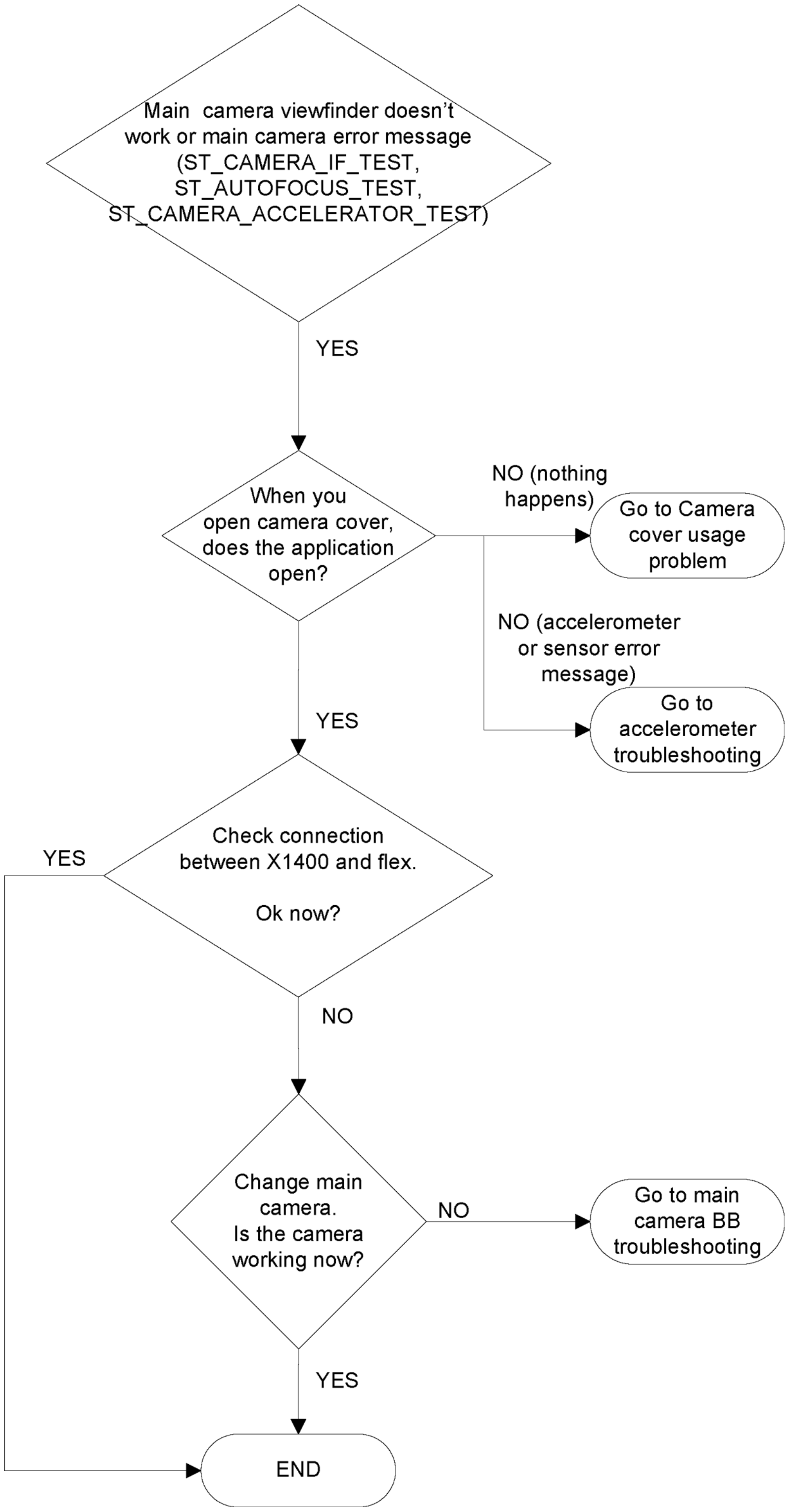


Figure 51 Light from the flash has reflected on particles in front of the camera

Main (back) camera troubleshooting flowcharts

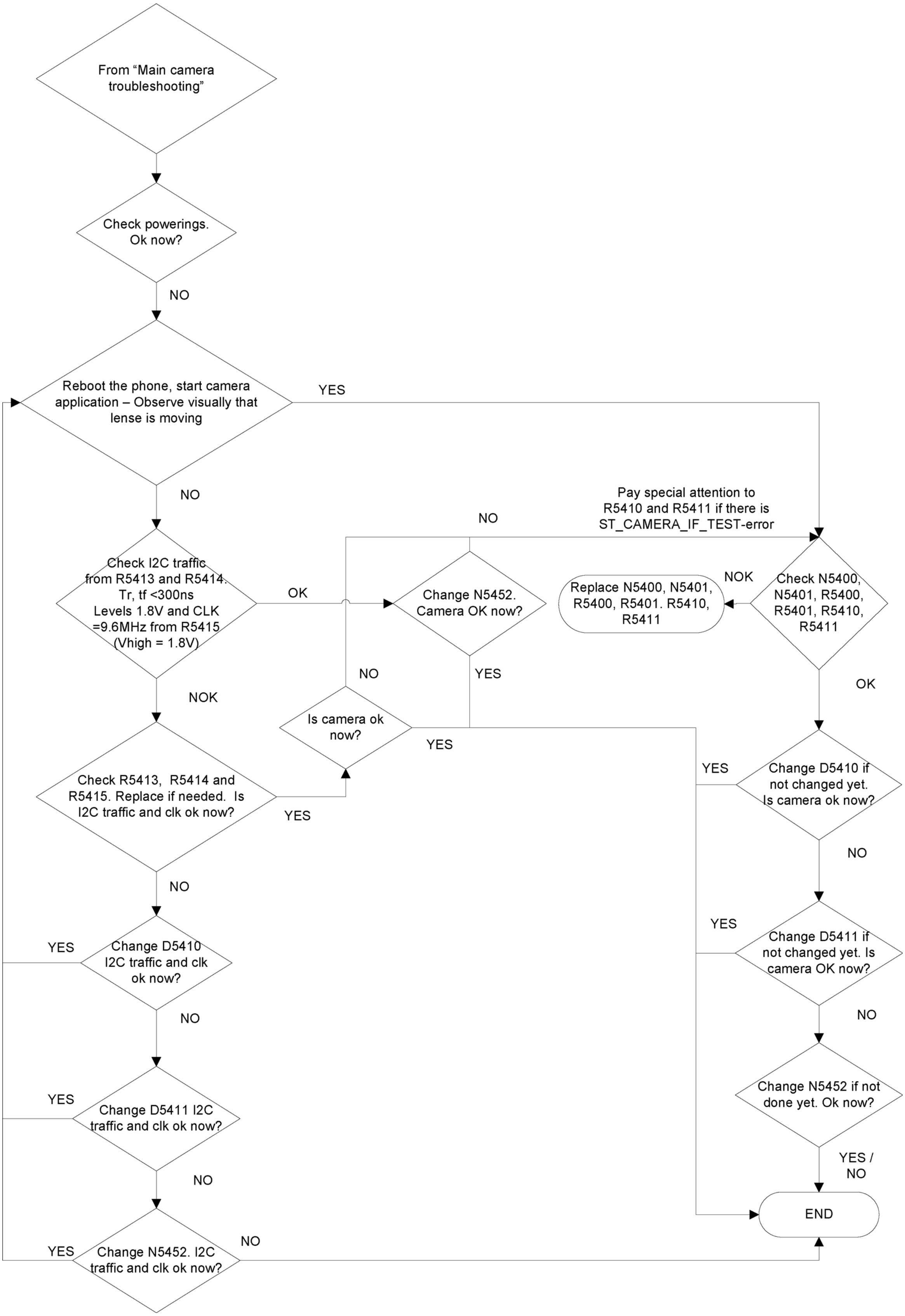
Main camera troubleshooting

Troubleshooting flow


Main camera viewfinder doesn't work or main camera error message (ST_CAMERA_IF_TEST, ST_AUTOFOCUS_TEST, ST_CAMERA_ACCELERATOR_TEST)
YES
When you open camera cover, does the application open?
NO (nothing happens)
Go to Camera cover usage problem
NO (accelerometer or sensor error message)
Go to accelerometer troubleshooting
YES
Check connection between X1400 and flex.
Ok now?
YES
NO
Change main camera.
Is the camera working now?
NO
Go to main camera BB troubleshooting
YES
END

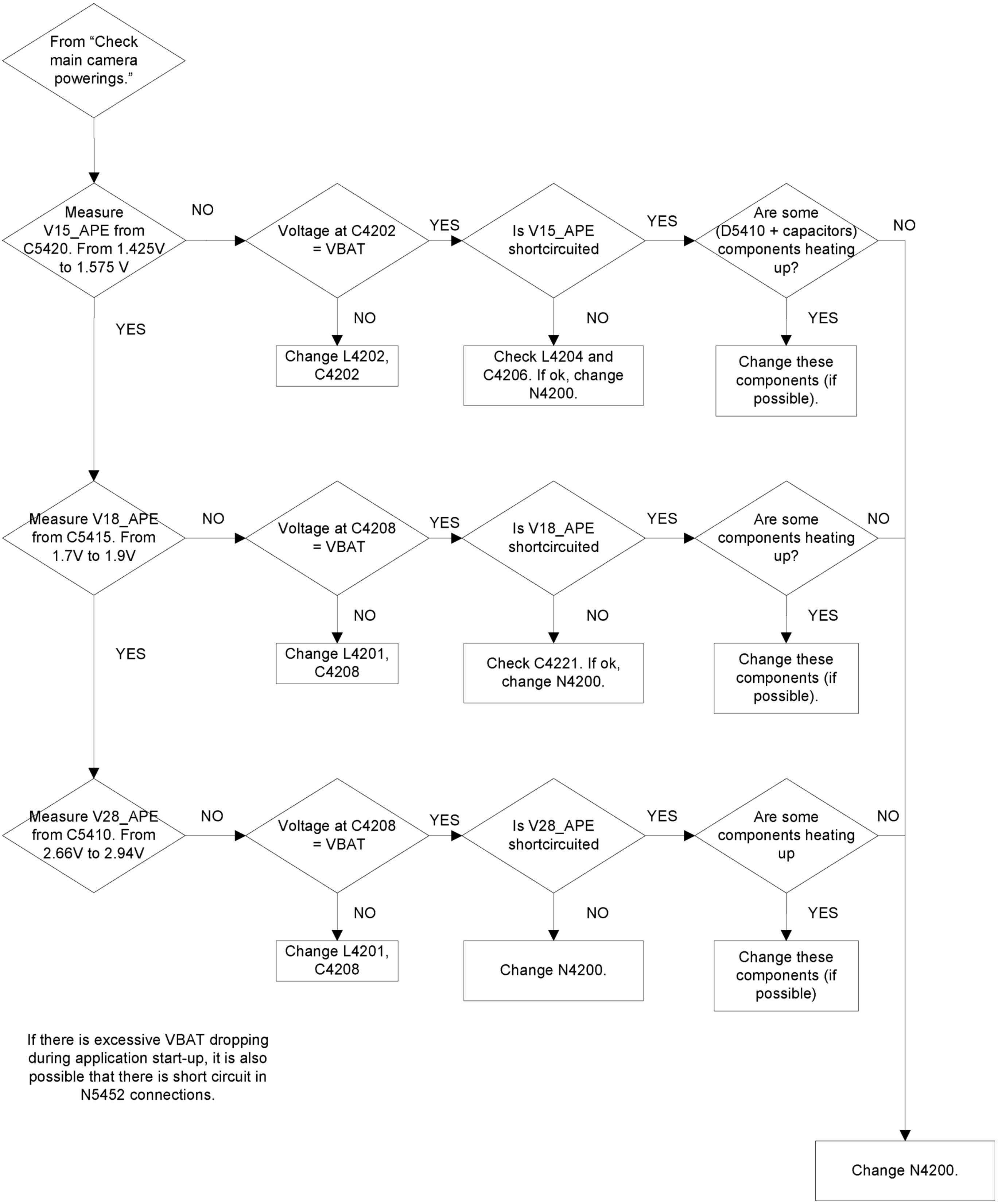
Main camera baseband troubleshooting

Troubleshooting flow


From "Main camera troubleshooting"
Check powerings. Ok now?
NO
Reboot the phone, start camera application – Observe visually that lense is moving
YES
NO
Check I2C traffic from R5413 and R5414. Tr, tf <300ns Levels 1.8V and CLK =9.6MHz from R5415 (Vhigh = 1.8V)
OK
NOK
Change N5452. Camera OK now?
NO
YES
Pay special attention to R5410 and R5411 if there is ST_CAMERA_IF_TEST-error
Check N5400, N5401, R5400, R5401, R5410, R5411
NOK
Replace N5400, N5401, R5400, R5401. R5410, R5411
OK
Is camera ok now?
NO
YES
Check R5413, R5414 and R5415. Replace if needed. Is I2C traffic and clk ok now?
YES
NO
Change D5410 if not changed yet. Is camera ok now?
YES
NO
Change D5411 if not changed yet. Is camera OK now?
YES
NO
Change N5452 if not done yet. Ok now?
YES / NO
END
Change D5410 I2C traffic and clk ok now?
YES
NO
Change D5411 I2C traffic and clk ok now?
YES
NO
Change N5452. I2C traffic and clk ok now?
YES
NO

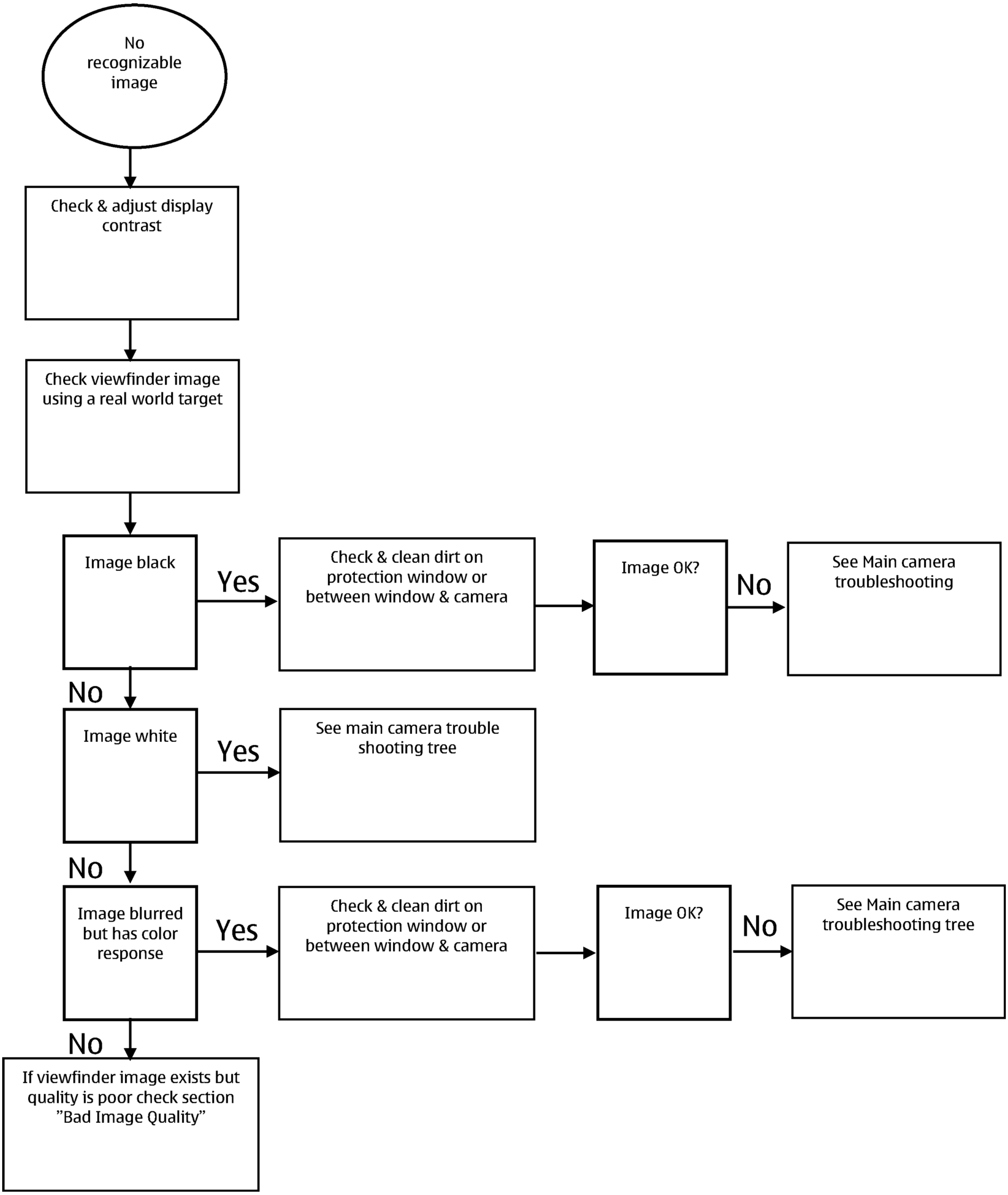
Main camera baseband troubleshooting - powerings

Troubleshooting flow


From "Check main camera powerings."
Measure V15_APE from C5420. From 1.425V to 1.575 V
NO
YES
Voltage at C4202 = VBAT
YES
NO
Change L4202, C4202
Is V15_APE shortcircuited
YES
NO
Check L4204 and C4206. If ok, change N4200.
Are some (D5410 + capacitors) components heating up?
NO
YES
Change these components (if possible).
Measure V18_APE from C5415. From 1.7V to 1.9V
NO
YES
Voltage at C4208 = VBAT
YES
NO
Change L4201, C4208
Is V18_APE shortcircuited
YES
NO
Check C4221. If ok, change N4200.
Are some components heating up?
NO
YES
Change these components (if possible).
Measure V28_APE from C5410. From 2.66V to 2.94V
NO
Voltage at C4208 = VBAT
YES
NO
Change L4201, C4208
Is V28_APE shortcircuited
YES
NO
Change N4200.
Are some components heating up
NO
YES
Change these components (if possible)
If there is excessive VBAT dropping during application start-up, it is also possible that there is short circuit in N5452 connections.
Change N4200.

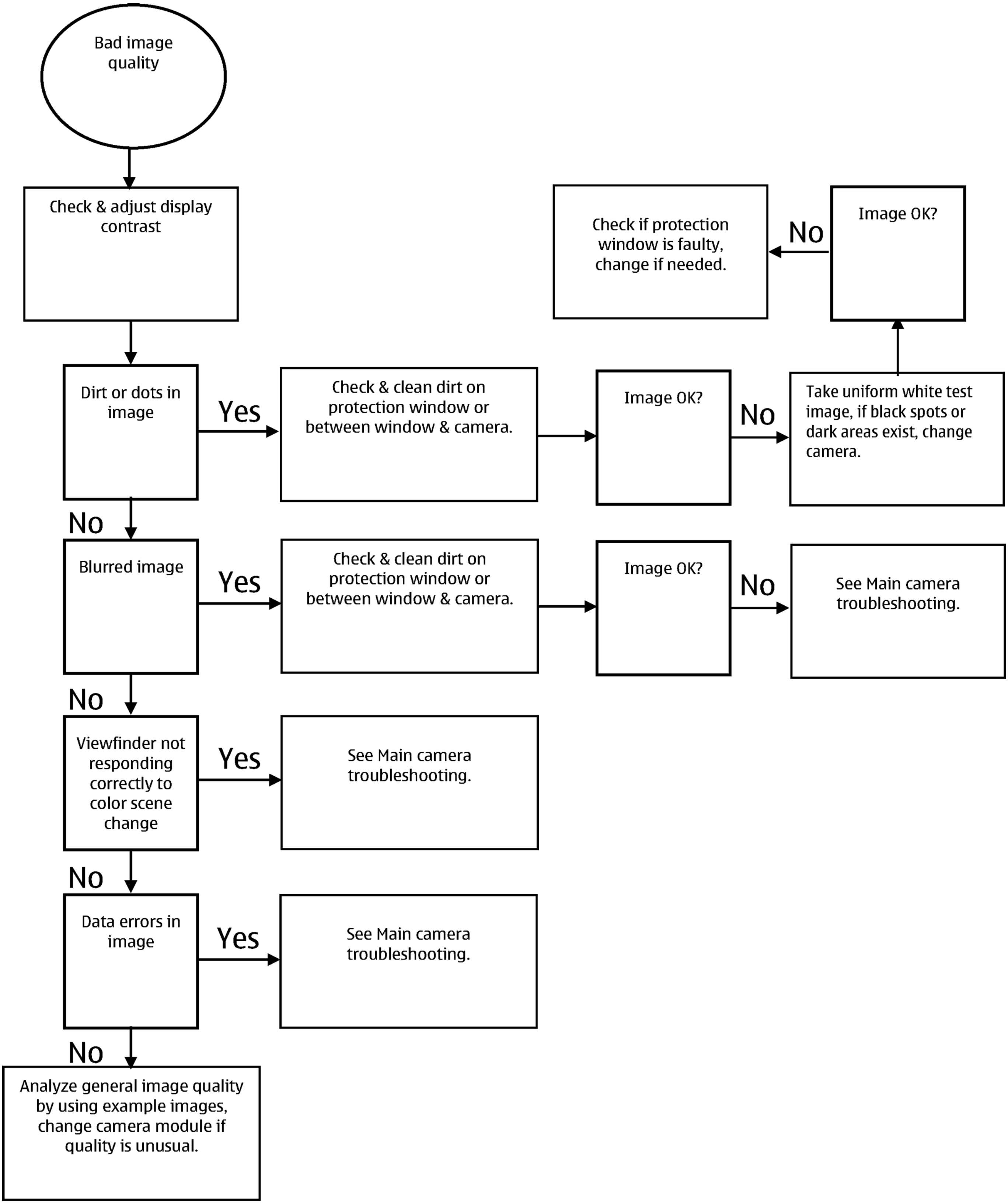
No recognizable viewfinder image

Troubleshooting flow


No recognizable image
Check & adjust display contrast
Check viewfinder image using a real world target
Image black
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
See Main camera troubleshooting
No
Image white
Yes
See main camera trouble shooting tree
No
Image blurred but has color response
Yes
Check & clean dirt on protection window or between window & camera
Image OK?
No
See Main camera troubleshooting tree
No
If viewfinder image exists but quality is poor check section ”Bad Image Quality”

Bad image quality troubleshooting

Troubleshooting flow

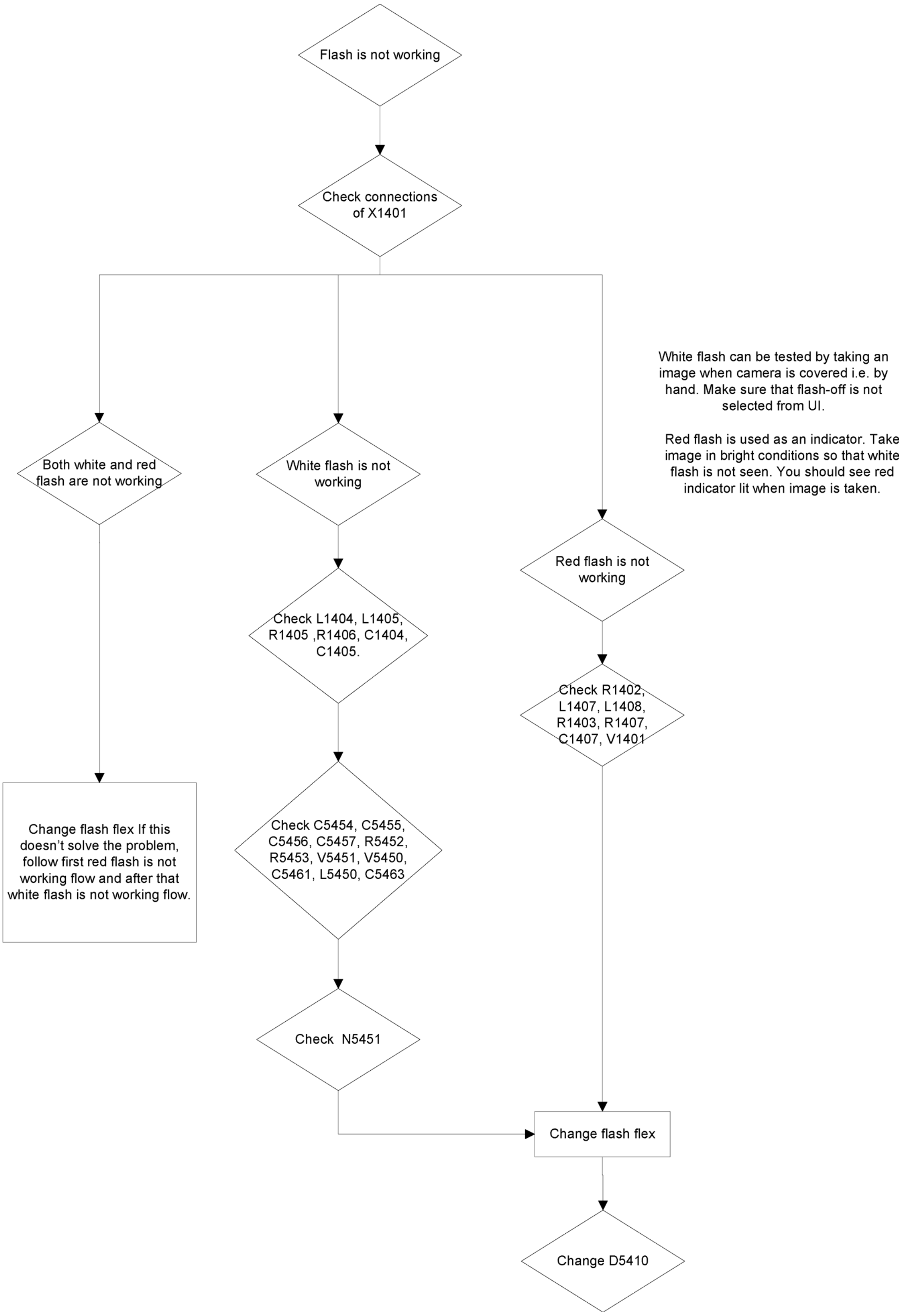

Bad image quality
Check & adjust display contrast
Dirt or dots in image
Yes
Check & clean dirt on protection window or between window & camera.
Image OK?
No
Take uniform white test image, if black spots or dark areas exist, change camera.
Image OK?
No
Check if protection window is faulty, change if needed.
No
Blurred image
Yes
Check & clean dirt on protection window or between window & camera.
Image OK?
No
See Main camera troubleshooting.
No
Viewfinder not responding correctly to color scene change
Yes
See Main camera troubleshooting.
No
Data errors in image
Yes
See Main camera troubleshooting.
No
Analyze general image quality by using example images, change camera module if quality is unusual.

Flash troubleshooting

Context

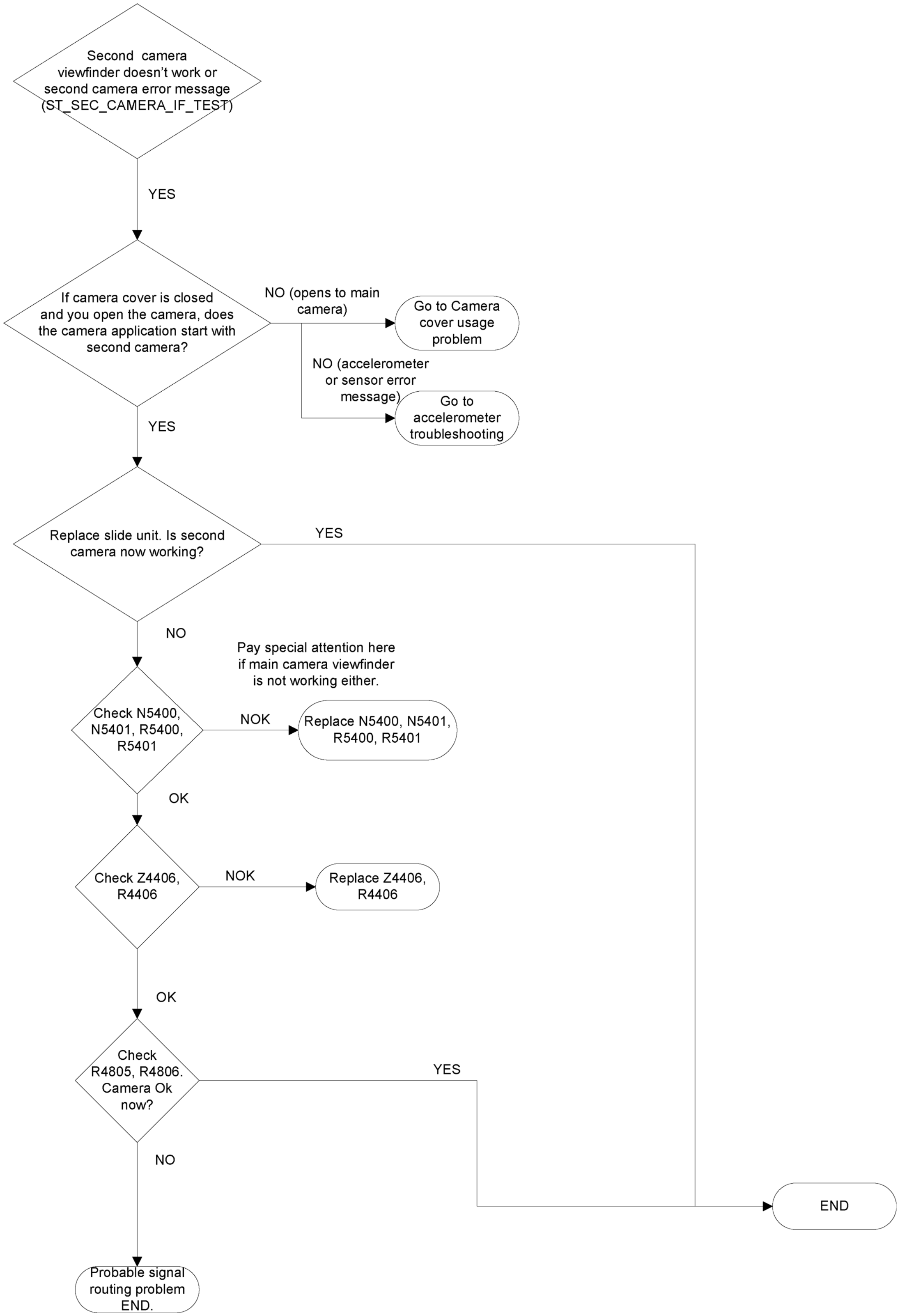
Note: Before checking flash functionality, make sure that the main camera is working ok.

Troubleshooting flow


Flash is not working
Check connections of X1401
Both white and red flash are not working
White flash is not working
Red flash is not working
White flash can be tested by taking an image when camera is covered i.e. by hand. Make sure that flash-off is not selected from UI.
Red flash is used as an indicator. Take image in bright conditions so that white flash is not seen. You should see red indicator lit when image is taken.
Change flash flex If this doesn't solve the problem, follow first red flash is not working flow and after that white flash is not working flow.
Check L1404, L1405, R1405 ,R1406, C1404, C1405.
Check C5454, C5455, C5456, C5457, R5452, R5453, V5451, V5450, C5461, L5450, C5463
Check N5451
Check R1402, L1407, L1408, R1403, R1407, C1407, V1401
Change flash flex
Change D5410

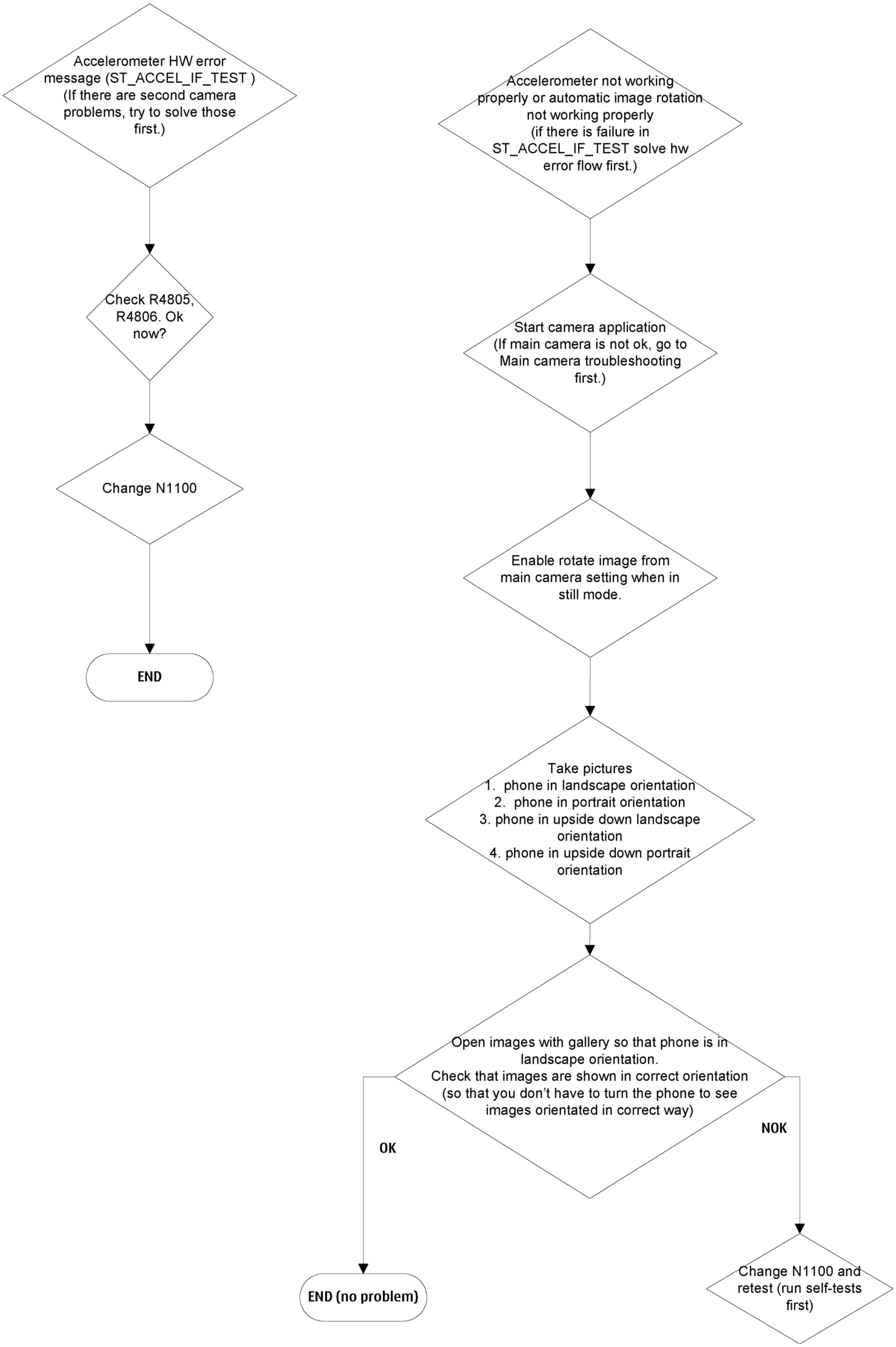
Secondary (front) camera troubleshooting flow

Troubleshooting flow


Second camera viewfinder doesn't work or second camera error message (ST_SEC_CAMERA_IF_TEST)
YES
If camera cover is closed and you open the camera, does the camera application start with second camera?
NO (opens to main camera)
Go to Camera cover usage problem
NO (accelerometer or sensor error message)
Go to accelerometer troubleshooting
YES
Replace slide unit. Is second camera now working?
YES
NO
Pay special attention here if main camera viewfinder is not working either.
Check N5400, N5401, R5400, R5401
NOK
Replace N5400, N5401, R5400, R5401
OK
Check Z4406, R4406
NOK
Replace Z4406, R4406
OK
Check R4805, R4806. Camera Ok now?
YES
END
NO
Probable signal routing problem END.

Accelerometer troubleshooting

Troubleshooting flow


Accelerometer HW error message (ST_ACCEL_IF_TEST) (If there are second camera problems, try to solve those first.)
Check R4805, R4806. Ok now?
Change N1100
END
Accelerometer not working properly or automatic image rotation not working properly (if there is failure in ST_ACCEL_IF_TEST solve hw error flow first.)
Start camera application (If main camera is not ok, go to Main camera troubleshooting first.)
Enable rotate image from main camera setting when in still mode.
Take pictures
1. phone in landscape orientation
2. phone in portrait orientation
3. phone in upside down landscape orientation
4. phone in upside down portrait orientation
Open images with gallery so that phone is in landscape orientation. Check that images are shown in correct orientation (so that you don't have to turn the phone to see images orientated in correct way)
OK
NOK
END (no problem)
Change N1100 and retest (run self-tests first)

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6 — FMTx 2.1 Technical Description

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Table of Contents

Glossary 6–5
FMTx2.1 HW block..6–5
Device pin layout (Si4713-GM) and interfaces..6–7

List of Figures

Figure 52 FMTx 2.1 system block diagram..6–6

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Glossary

AF	Audio Frequency
RF	Radio Frequency
FM	Frequency Modulation
Tx	Transmitter
Rx	Receiver
FMTx	FM Transmitter
LPD	Low Power Device
LNA	Low Noise Amplifier
LDO	Low Drop Out regulator
RSSI	Received Signal Strength Indicator (same as RPS)
RPS	Received Power Scan (Same as RSSI)
QFN	Quad Flat No-Lead

FMTx2.1 HW block

The FMTx 2.1 implementation is based on the Silicon Laboratories Si4713 low power FM transmitter device. This device has some state of the art features which have been utilised in the Nokia implementation. Apart from having excellent RF transmitter performance and exceptional AF performance the device offers a number of unique features, including the ability to retune the output stage of the device to ensure optimal matching between the Tx antenna and the output stage of the device.

Functional description

The FMTx 2.1 solution comprises of the Si4713 device and ten external components. These components consist of:

- A filter - an inductor and a varistor for filtering of emissions from the chip
- ESD protection - a resistor and diode package
- A dual capacitor package which is connected to the analogue audio input pins LIN & RIN. The fundamental purpose of these capacitors is as DC blocking caps
- A filter on the reset line comprising a capacitor and a resistor
- An antenna which also provides the inductive load required by the Si4713 device

The Si4713 device is in a 3 x 3mm 20 pin QFN package.

Current implementations make use of the DAC33 device which allows data to be digitally clocked into the DAC at high data rates, buffered and then streamed out at the correct rate while the rest of the baseband is put to sleep in order to save power. This solution significantly increases playback time of audio content.

The Si4713 device has the following features:

- 88.1MHz – 107.9MHz FM band support.
- Programmable pre-emphasis (50/75us).
- Analogue audio interface
- Audio silence/signal present detection.

- Programmable reference clock.
- RDS/RBDS encoder
- Loop and monopole antenna support with self-calibrated capacitor tuning.
- Programmable transmit level.
- Audio dynamic range control.

System block diagram

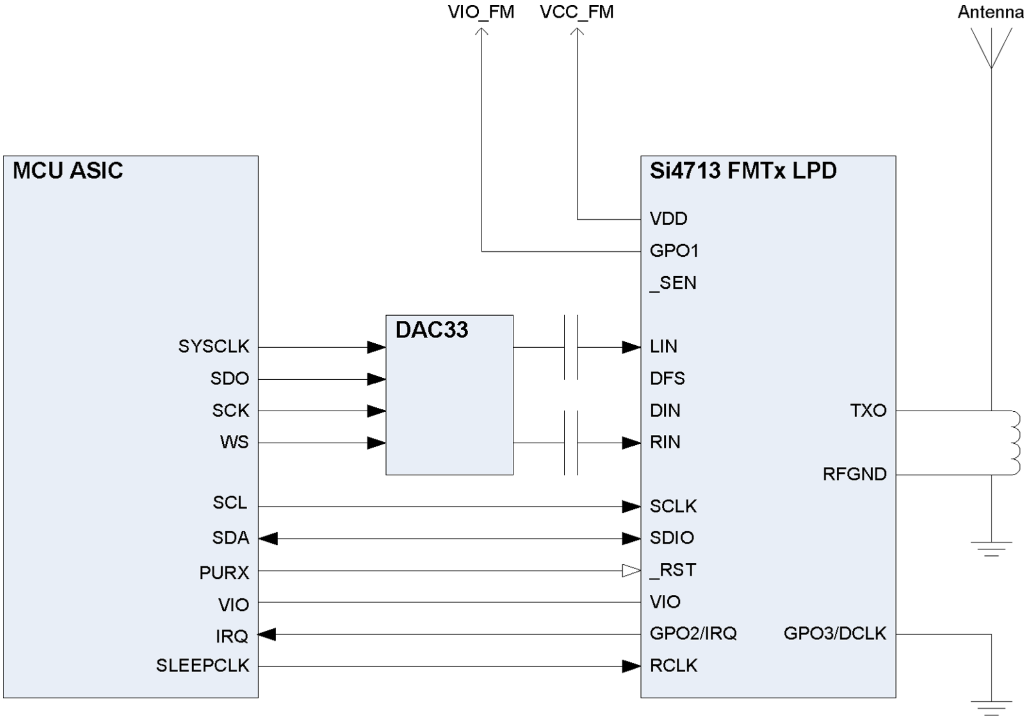
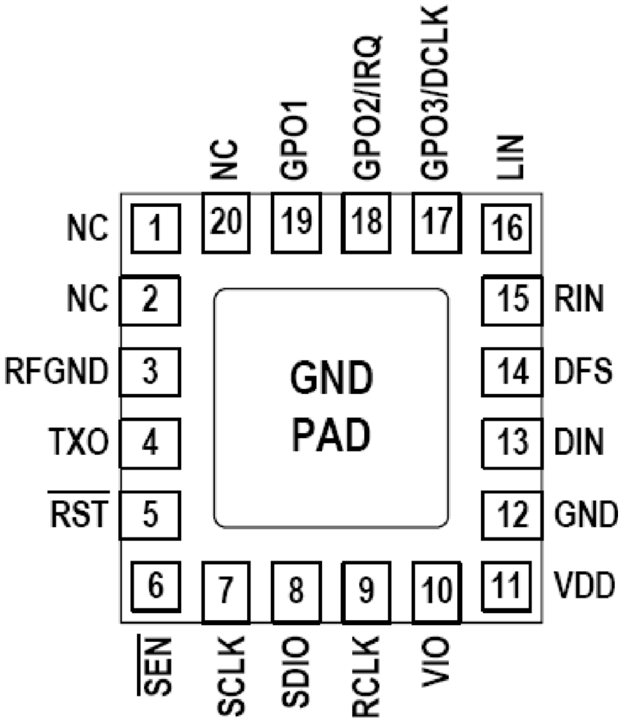

VIO_FM
VCC_FM
Antenna
MCU ASIC
SYSCLK
SDO
SCK
WS
SCL
SDA
PURX
VIO
IRQ
SLEEPCLK
DAC33
Si4713 FMTx LPD
VDD
GPO1
_SEN
LIN
DFS
DIN
RIN
SCLK
SDIO
_RST
VIO
GPO2/IRQ
RCLK
TXO
RFGND
GPO3/DCLK

Figure 52 FMTx 2.1 system block diagram

The figure above shows the basic system block diagram for the FMTx 2.1 implementation. _SEN is shown here unconnected since this pin decides which I2C address is used depending on if this pin is pulled low or high. On RM-333 the _SEN is pulled high by connecting it to VIO.

RM-333 uses a loop antenna which is located in the removable C-cover of the device. The loop antenna also acts as the tuning inductor which is required by the Si4713 chip. The location of the antenna in the removable cover means that ESD protection is required to prevent damage to the Si4713 device.

Device pin layout (Si4713-GM) and interfaces


NC
GPO1
GPO2/IRQ
GPO3/DCLK
LIN
NC 1
20
19
18
17
16
NC 2
15 RIN
RFGND 3
14 DFS
TXO 4
13 DIN
RST 5
12 GND
GND PAD
6
7
8
9
10
11 VDD
SEN
SCLK
SDIO
RCLK
VIO

Inteface pin descriptions

Pin Number(s)	Name	Description
1, 2, 20	NC	No connect, left floating.
3	RFGND	RF ground. Connected to ground plane on PCB.
4	TXO	FM transmitter output connection to Tx antenna.
5	RST	Device reset (active low) input.
6	SEN	Serial enable input (active low).
7	SCLK	Serial clock input.
8	SDIO	Serial data input/output.
9	RCLK	External reference oscillator input.
10	VIO	I/O supply voltage.
11	VDD	Supply voltage.
13	DIN	Digital input data.
14	DFS	Digital frame synchronisation.
15	RIN	Right audio line input.
16	LIN	Left audio line input.
17	GPO3/DCLK	General purpose output – Digital bit synchronous clock.

Pin Number(s)	Name	Description
18	GPO2/IRQ	General purpose output – Interrupt request.
19	GPO1	General purpose output.
12, GND PAD	GND	Ground. Connect to ground plane on PCB.

7 — FMTx 2.1 Troubleshooting

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Table of Contents

FMTx 2.1 schematic 7–5
FMTx 2.1 component layout 7–5
FMTx 2.1 PWB traces 7–6
Specific digital and power supply test points 7–6
FMTx2.1 specific RF test points 7–7
Specific clock test points........ 7–7
General visual inspection guidelines........ 7–7
FMTx2.1 troubleshooting........ 7–8
FMTx2.1 antenna visual inspection troubleshooting 7–9
FMTx2.1 audio path visual inspection troubleshooting 7–10
FMTx2.1 Si4713 visual inspection troubleshooting 7–11
Checking validity of signals 7–11
FMTx2.1 troubleshooting faults 7–12
Phoenix PC tool........ 7–12

List of Tables

Table 6 Bus mode selection truth table 7–6
Table 7 I2C 7-bit bus address selection summary........ 7–7
Table 8 Left and right audio self test truth table........ 7–15

List of Figures

Figure 53 FMTx 2.1 schematic 7–5
Figure 54 FMTx 2.1 Component References and Location........ 7–5
Figure 55 FMTx 2.1 layout........ 7–6
Figure 56 FMTx panel before connection to the handset........ 7–13
Figure 57 FMTx panel after connection to the handset........ 7–13
Figure 58 FMTx panel in action 7–15

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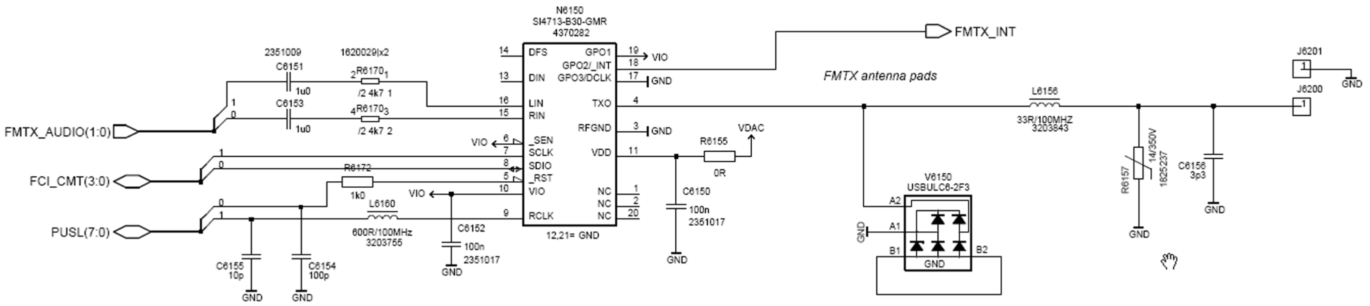
FMTx 2.1 schematic


N6150
SI4713-B30-GMR
4370282
2351009
C6151
1u0
C6153
1u0
1620029|x2
2R61701
/2 4k7 1
4R61703
/2 4k7 2
FMTX_AUDIO(1:0)
FCI_CMT(3:0)
PUSL(7:0)
R6172
1k0
L6160
600R/100MHz
3203755
C6155
10p
C6154
100p
C6152
100n
2351017
GND
VIO
DFS
DIN
LIN
RIN
_SEN
SCLK
SDIO
_RST
VIO
RCLK
GPO1
GPO2/_INT
GPO3/DCLK
TXO
RFGND
VDD
NC
12,21= GND
FMTX_INT
FMTX antenna pads
R6155
0R
VDAC
C6150
100n
2351017
V6150
USBULC6-2F3
A1
A2
B1
B2
L6156
33R/100MHZ
3203843
R6157
14/350V
1825237
C6156
3p3
J6201
J6200

Check reset and connections in general.

Figure 53 FMTx 2.1 schematic

The handset uses an antenna that is integral to the removable cover. The connection to the cover is exposed when the cover is removed.

The loop antenna requires two connection points, J6200 and J6201 (the signal and the ground). It is important to check these connection points for damage or dirt since the performance of the FMTx 2.1 implementation will be severely impaired if these connections are not in good condition.

FMTx 2.1 component layout

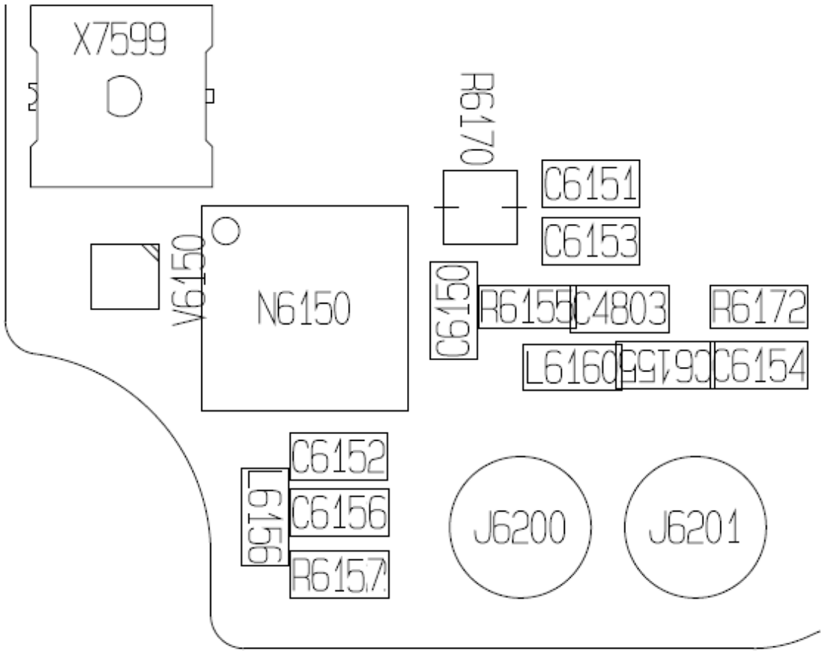

X7599
R6170
C6151
C6153
V6150
N6150
C6150
R6155
C4803
R6172
L6160
C6155
C6154
C6152
L6156
C6156
R6157
J6200
J6201

Figure 54 FMTx 2.1 Component References and Location

The main component of the FMTx 2.1 solution is the Si4713 low power transmitter device (N6150).

FMTx 2.1 PWB traces

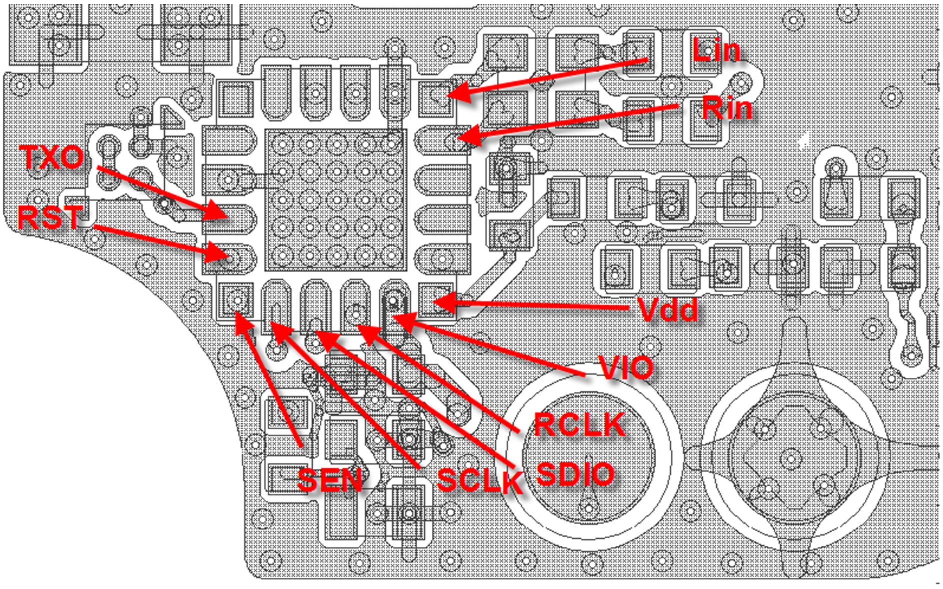


Figure 55 FMTx 2.1 layout

Specific digital and power supply test points

Using access to signals figure as a reference it can be seen that supplies to the Si4713 device VIO (pin 10) and VDD (pin 11) can be accessed easily. The FMTx 2.1 solution utilises a QFN package. This type of package lends itself well to analysis of signals on the various pins of the device.

VIO & VDD

VIO should be in the range 1.5 to 3.6 Volts.

VDD should be in the range 2.7 to 5.5 Volts.

_RST

Also, the _RST signal to the device can be monitored. This is an active low signal and should only be asserted during power up. The _RST signal is driven by the PURX line.

The state of pins 19 & 18 (GP01 and GP02 respectively) on the rising edge of the _RST pin determines what interface is selected when the device powers up.

Table 6 Bus mode selection truth table

Bus Name	Bus Mode	GP01	GP02/IRQ
I2C	2-Wire	High	Low
SPI	SPI	High	Low (must drive)
CBus	3-Wire	Low (must drive)	Low

It's possible that if GP01 and/or GP02 are not at the correct state when the Si4713 device has power applied then the wrong bus mode could be selected and the handset would be unable to communicate with the device. For RM-333, the bus mode should be I2C.

_SEN

The _SEN pin is used to select one of two possible 7-bit I2C bus addresses. When _SEN is low, the I2C bus address for the Si4713 device is 0010001 (0x11). When _SEN is high, the I2C bus address for the Si4713 is 1100011 (0x63).

If the _SEN signal is not correct (i.e. not selecting the correct I2C address), then this is also another possible reason why control of the FMTx 2.1 feature might not be possible. For RM-333 the I2C address used for FMTx 2.1 will be 0x63.

Table 7 I2C 7-bit bus address selection summary

I2C address	_SEN
0010001 (0x11).	High
1100011 (0x63).	Low

FMTx2.1 specific RF test points

TXO

Pin 4 is the TXO pin. This is the transmitter output pin and probe access can be obtained easily. Using a high impedance probe and a spectrum analyser it would be possible to examine the TXO pin and check that the transmitter is outputting a signal.

Specific clock test points

RCLK

Pin 9 is the RCLK (Reference Clock) input to the device. This is typically 32.768KHz and is driven from the sleep clock from the base band. When measuring this clock frequency, it may be seen to vary by as much as +/- 120 ~ 200ppm. The device can only typically tolerate +/- 20ppm in order to maintain transmit frequency accuracy. To overcome this, the software driver for the device calculates what the actual sleep clock (RCLK) frequency is and periodically programs the device with this frequency.

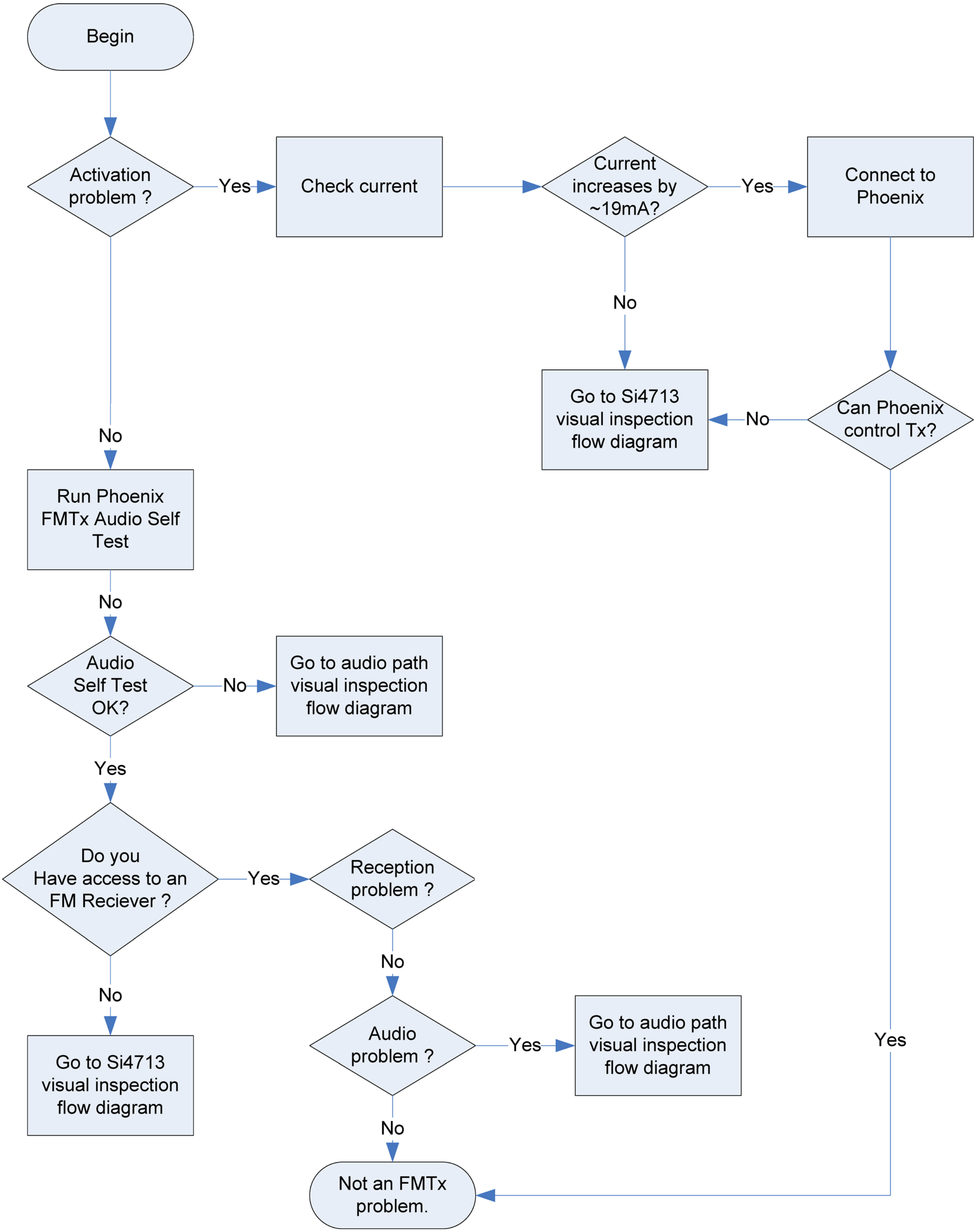
The device then internally adjusts its dividers in order to maintain the required output frequency. Using this method it is possible to reduce the effective ppm of the reference clock down to +/- 14ppm over the full operating temperature range of -15 to +50 degrees Centigrade.

General visual inspection guidelines

- If the handset has the FMTx antenna in the back cover then check the condition of the cover, the antenna trace and any mechanical interfaces for the antenna e.g. pogo pins.
- Check that the Si4713 device is placed correctly on the PWB and that there are no obvious signs of damage.
- Check the surrounding components and ensure correct placement on the PWB and that there is no visual damage. Check that there are no missing components.

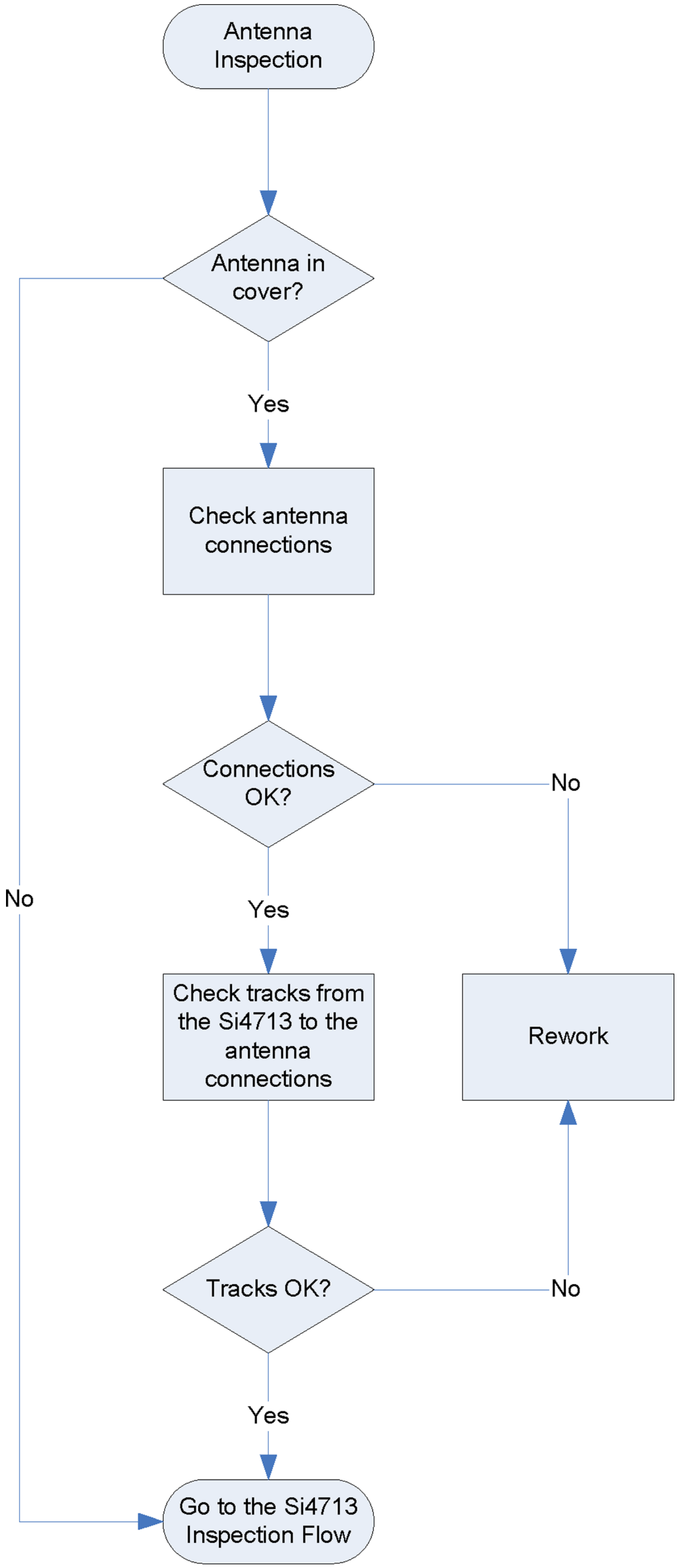
FMTx2.1 troubleshooting

Troubleshooting flow


Begin
Activation problem ?
Yes
Check current
Current increases by ~19mA?
Yes
Connect to Phoenix
No
Go to Si4713 visual inspection flow diagram
No
Can Phoenix control Tx?
No
Run Phoenix FMTx Audio Self Test
No
Audio Self Test OK?
No
Go to audio path visual inspection flow diagram
Yes
Do you Have access to an FM Reciever ?
Yes
Reception problem ?
No
No
Audio problem ?
Yes
Go to audio path visual inspection flow diagram
Yes
Go to Si4713 visual inspection flow diagram
No
Not an FMTx problem.

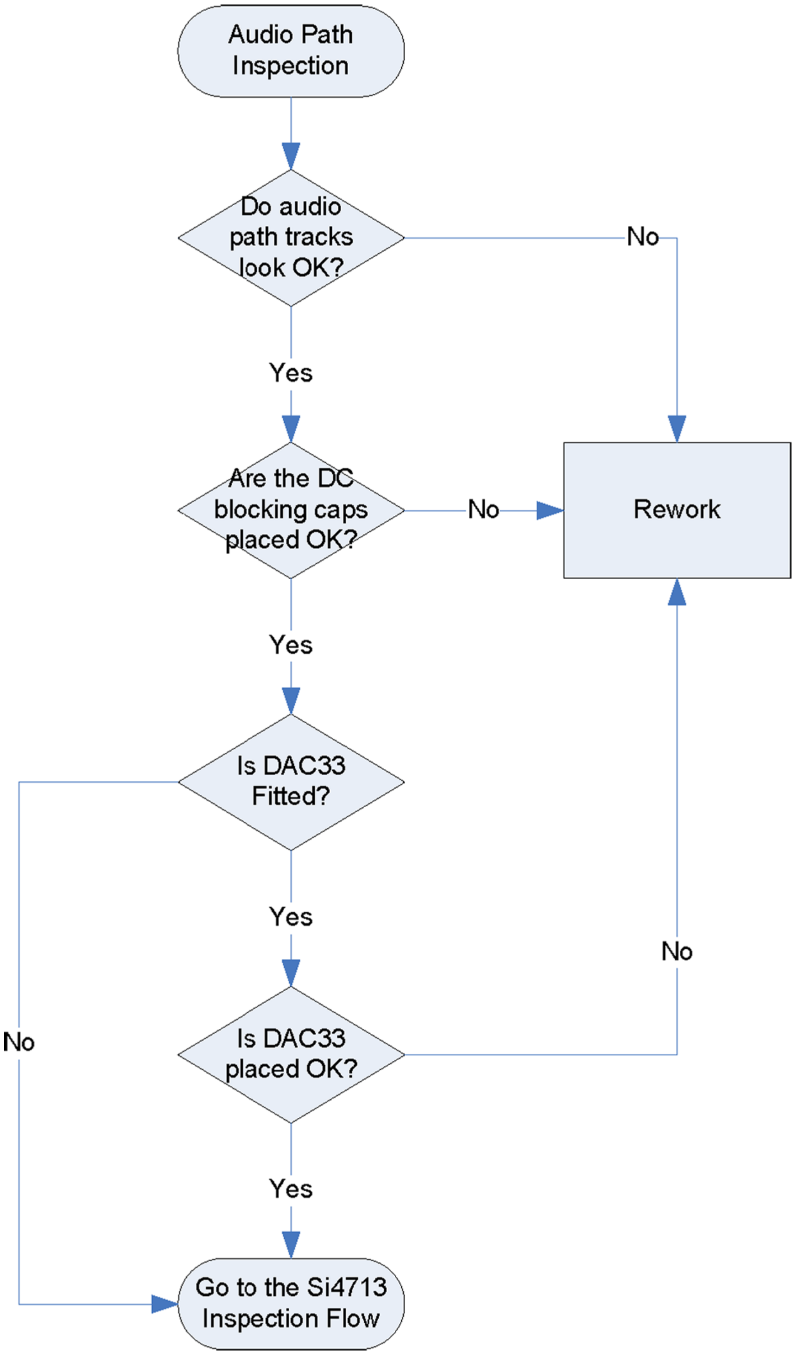
FMTx2.1 antenna visual inspection troubleshooting

Troubleshooting flow


Antenna Inspection
Antenna in cover?
Yes
No
Check antenna connections
Connections OK?
Yes
No
Check tracks from the Si4713 to the antenna connections
Rework
Tracks OK?
Yes
No
Go to the Si4713 Inspection Flow

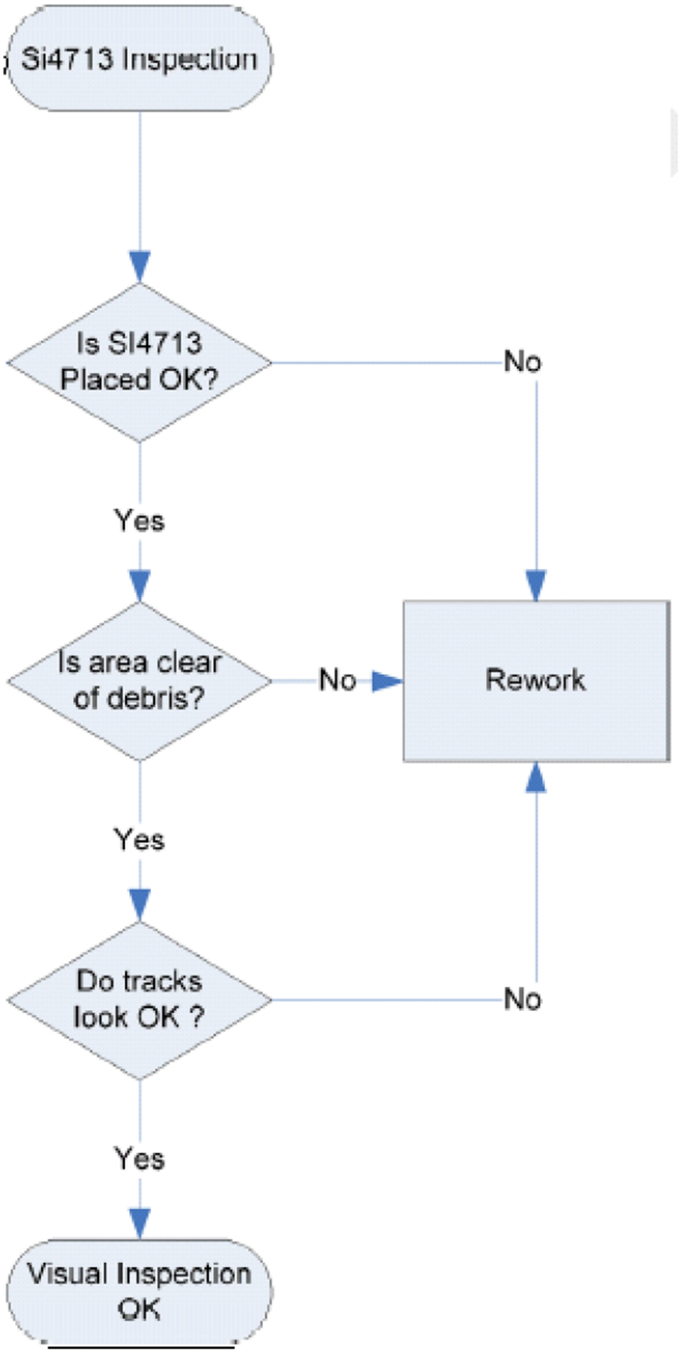
FMTx2.1 audio path visual inspection troubleshooting

Troubleshooting flow


Audio Path Inspection
Do audio path tracks look OK?
No
Yes
Are the DC blocking caps placed OK?
No
Rework
Yes
Is DAC33 Fitted?
Yes
No
Is DAC33 placed OK?
No
Yes
Go to the Si4713 Inspection Flow

FMTx2.1 Si4713 visual inspection troubleshooting

Troubleshooting flow


Si4713 Inspection
Is SI4713 Placed OK?
No
Yes
Is area clear of debris?
No
Rework
Yes
Do tracks look OK ?
No
Yes
Visual Inspection OK

Checking validity of signals

Please refer to **Access to signals** figure as a reference. Generally all power supply levels and clocks willbe consistent. Signals on the analogue audio input pins (RIN & LIN – pins 15 and 16 respectively) will be dependant on the audio content being injected to the device. During the audio self test (initiated from Phoenix) it is possible to monitor these pins and check that the DSP generated 1KHz tones can be seen at some point during the test. Check that the signals are clean and that no obvious distortion can be seen such as clipping of the signals. Typical maximum swing of these tones will be ~636mV peak to peak. The maximum swing may vary between Nokia handsets but for the FMTx 2.1 implementation, the swing should not be greater than the aforementioned value.

FMTx2.1 troubleshooting faults

Possible faults

Expected fault reports relating to the FMTx 2.1 implementation may consist of one or more of the following;

1. No left audio
2. No right audio
3. No audio
4. Can’t start FMTx
5. Can’t locate FM transmission on an FM receiver or no FM transmission
6. Distortion on audio
7. Poor reception on FM receiver
8. No RDS information

Initial fault analysis

Where possible, attempt to reproduce and verify the reported fault. Intermittent problems are likely to be due to bad connections or broken components/solder joints. Any faults relating to poor FM transmitter performance or frequent failure to locate usable frequencies when performing a scan are likely to be due to some kind of antenna issues.

In handsets that utilise an antenna solution in a removable cover it is likely that the connecting interface pins are either damaged, dirty or that the cover fits poorly perhaps due to broken tabs/latching lugs. Poor audio fault reports may also be due to the above antenna issues.

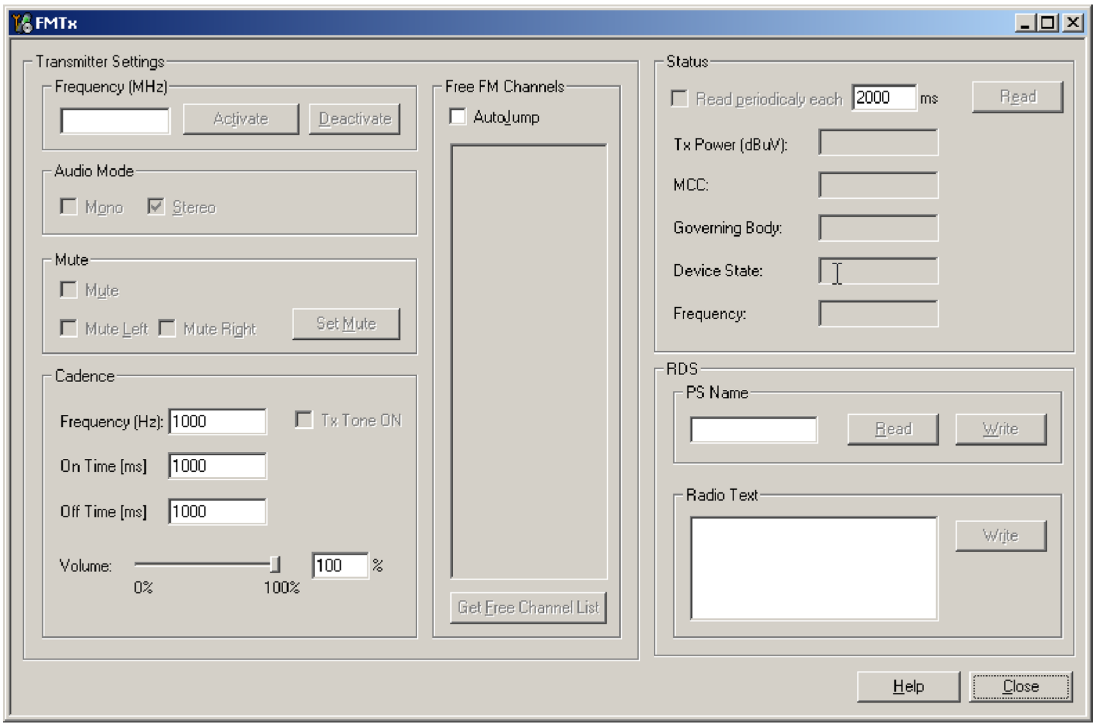
Phoenix PC tool

Setting Up Phoenix

Required equipment:

- A Deskey security dongle for Phoenix to run.
- The latest version of Phoenix that has the FMTx 2.1 GUI installed on a PC (version 2007.21.000.27897 or greater).
- A jig suitable for the handset.
- A cable to connect the jig/handset to the PC. Run Phoenix and select the FMTx panel.

Using the FMTx panel to drive the FMTx 2.1 features


FMTx
Transmitter Settings
Frequency (MHz)
Activate
Deactivate
Audio Mode
Mute
Set Mute
Cadence
Free FM Channels
Get Free Channel List
Status
Read
RDS
PS Name
Read
Write
Radio Text
Write
Help
Close

Frequency (MHz):

☐ Mono ☑ Stereo

☐ Mute

☐ Mute Left ☐ Mute Right

Frequency (Hz): 1000 ☐ Tx Tone ON

On Time [ms] 1000

Off Time [ms] 1000

Volume: 100 % (0% – 100%)

☐ AutoJump

☐ Read periodicaly each 2000 ms

Tx Power (dBuV):

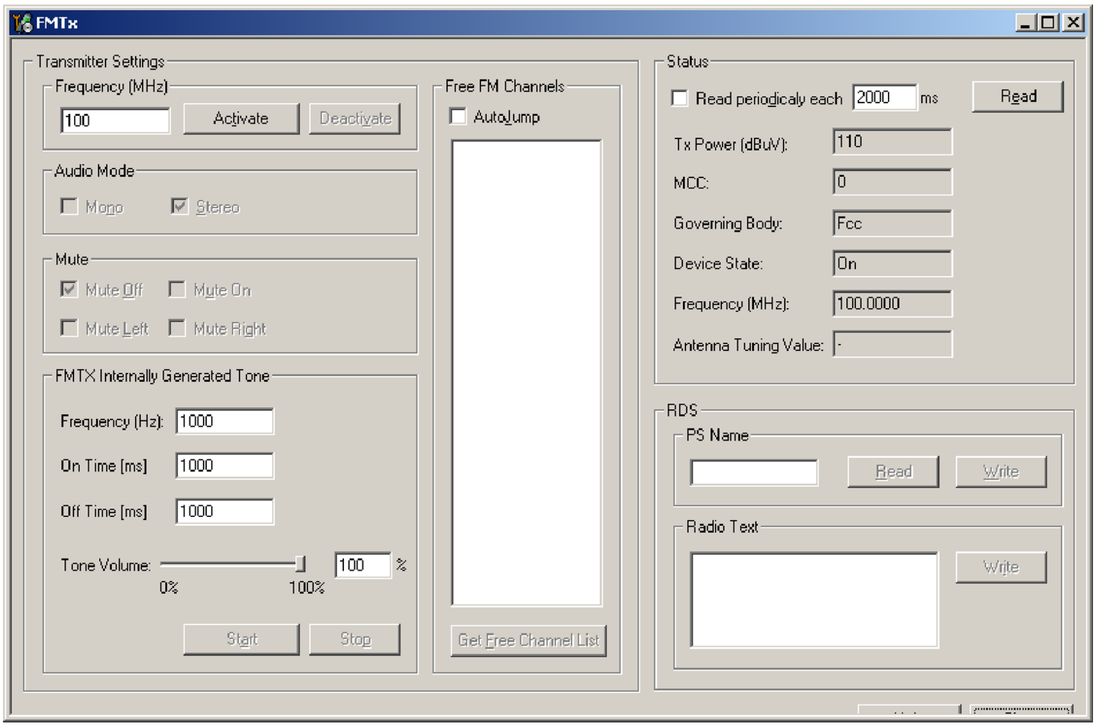
MCC:

Governing Body:

Device State:

Frequency:

Figure 56 FMTx panel before connection to the handset


FMTx
Transmitter Settings
Frequency (MHz)
Activate
Deactivate
Audio Mode
Mute
FMTX Internally Generated Tone
Start
Stop
Free FM Channels
Get Free Channel List
Status
Read
RDS
PS Name
Read
Write
Radio Text
Write

Frequency (MHz): 100

☐ Mono ☑ Stereo

☑ Mute Off ☐ Mute On

☐ Mute Left ☐ Mute Right

Frequency (Hz): 1000

On Time [ms] 1000

Off Time [ms] 1000

Tone Volume: 100 % (0% – 100%)

☐ AutoJump

☐ Read periodicaly each 2000 ms

Tx Power (dBuV): 110

MCC: 0

Governing Body: Fcc

Device State: On

Frequency (MHz): 100.0000

Antenna Tuning Value: -

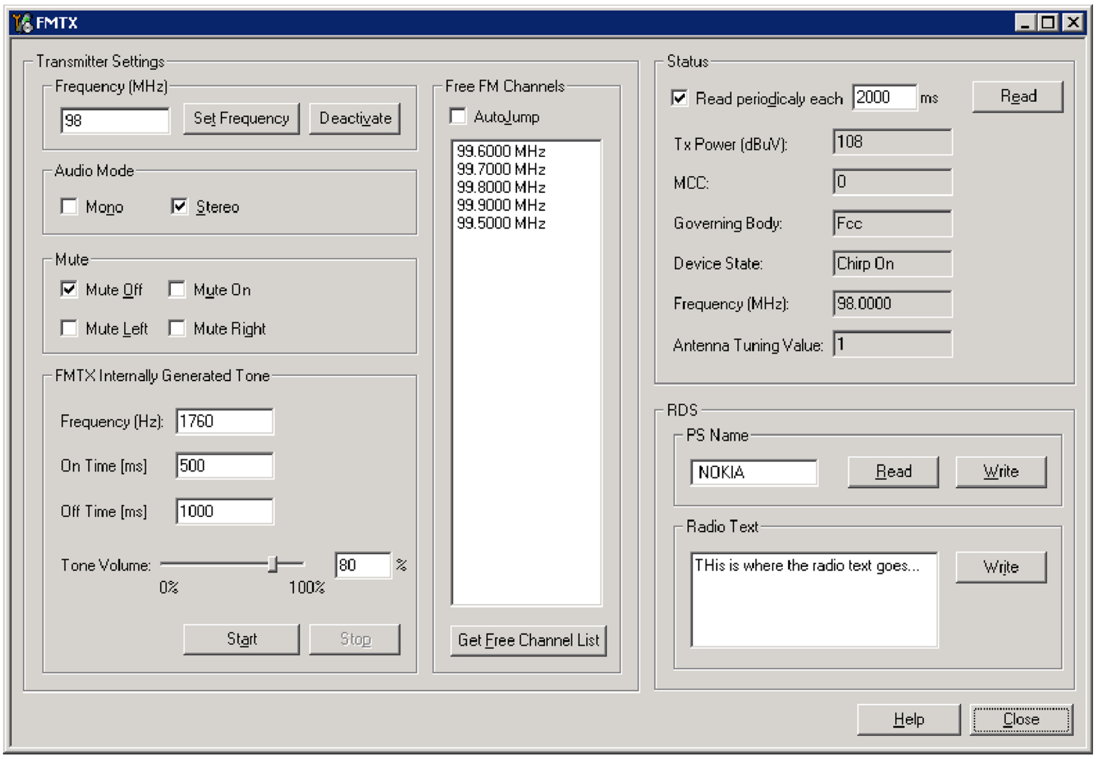
Figure 57 FMTx panel after connection to the handset

Typing in a valid FM transmitter frequency and clicking on ‘Activate’ will turn on the FMTx feature and will begin transmitting the carrier on the selected frequency. Note: Unless this carrier signal is modulated with some audio (either via the music player or a DSP or Si4713 generated tone) then all that will be heard if an

FM receiver is tuned to the same frequency would be silence. After approximately 10 seconds of silence the handset should begin to 'chirp' periodically with a short 1Khz tone that repeats every 5 seconds. This indicates that there is no audio input and reminds the user that the feature is on.

The Phoenix FMTx 2.1 panel can be used to control the following features;

- Set the FM frequency to transmit on (88.1 to 107.9MHz).
- Select Stereo or Mono mode (generally all Nokia handsets will only use stereo)
- Mute both left and right audio channels.
- Mute only the left or the right audio channels.
- Allow an internal tone to be generated and transmitted from the Si4713 device. The audio frequency of this tone can be selected along with the on/off time and the volume of the tone. Selecting 0 (zero) in either the on or off time will produce a continuous tone.
- Obtain a list of suitable 'quiet or free' channels. This effectively performs an RSSI (RPS) scan to locate quiet channels to transmit on. If the 'AutoJump' tick box is checked then this list will be transmitted to the FM receiver to allow the handset to perform AF jumps. This is dependent on the Nokia handset and if the FM receiver is RDS capable. The use of AF feature allows an RDS capable FM receiver to follow the transmissions of the FM transmitter automatically.
- FMTx 2.1 status panel. This provides information on the state of the FMTx feature. This can be polled by Phoenix at regular intervals defined by the user when the 'Read periodically each...' check box is checked. The status can otherwise be read at any point by clicking on the 'Read' button. The MCC value is the 'Mobile Country Code' and provided the phone is registered on a network will provide the code pertaining to the country in which it resides. The antenna tuning value is a good indicator of the state of the antenna and the other components connected to the TXO pin. For RM-333 the tuning values should be in the range 0 – 80. Any value outside of this range will indicate some problem with the components connected to the TXO pin (including the antenna). In the case of a removable antenna, the cause of the out of range value is like to be because of a poor antenna connection. This might be because of broken or dirty connections between the handset and the cover in which the antenna is fitted.
- The RDS panel can be used to set the PS name and/or to enter a Radio Text (RT) string. If access to an FM receiver is available that supports RDS then these strings can be observed on the display of the FM receiver.


FMTX
Transmitter Settings
Set Frequency
Deactivate
Audio Mode
Mute
FMTX Internally Generated Tone
0%
100%
Start
Stop
Free FM Channels
Get Free Channel List
Status
Read
RDS
Read
Write
Write
Help
Close

Frequency (MHz): 98

☐ Mono ☑ Stereo

☑ Mute Off ☐ Mute On

☐ Mute Left ☐ Mute Right

Frequency (Hz): 1760

On Time [ms] 500

Off Time [ms] 1000

Tone Volume: 80 %

☐ AutoJump

99.6000 MHz
99.7000 MHz
99.8000 MHz
99.9000 MHz
99.5000 MHz

☑ Read periodicaly each 2000 ms

Tx Power (dBuV): 108

MCC: 0

Governing Body: Fcc

Device State: Chirp On

Frequency (MHz): 98.0000

Antenna Tuning Value: 1

PS Name: NOKIA

Radio Text: THis is where the radio text goes...

Figure 58 FMTx panel in action

Using the audio self test

The audio self test can be used to quickly determine if the left and right audio paths are intact.

The left and right audio connectivity self test process performs the following steps:

1 Measure and store silence.

2 Inject 1KHz tone (left or right) to give 75KHz deviation. Measure and store.

3 Inject same tone on both left and right analogue audio inputs. Measure and store. Compare result from (2) with result from (1). If the delta is NOT more than a specified threshold level then fail. This would indicate that the selected channel is open circuit. If an over deviation indication is detected on (2), then the audio channels must be shorted together. This is a fail condition. For (3), a returned value of zero is expected. This indicates that there is an over deviation condition which in turn indicates that the ‘other’ audio input channel is connected correctly.

If on (3) there is no over deviation response, then the ‘other’ channel must be open circuit at some point in the audio path. This is a fail condition.

The table shows the truth table for the left and right audio self test.

Table 8 Left and right audio self test truth table

LEFT	RIGHT	ASQ Condition	Comment
0	0	0	SILENCE
1	0	0	OPEN/SHORT
1	0	1	OK
1	0	2	SHORT
0	1	X	Don’t Care
0	1	X	Don’t Care

LEFT	RIGHT	ASQ Condition	Comment
0	1	X	Don’t Care
1	1	0	ALL OPEN/SHORT
1	1	1	OPEN
1	1	2	OK

Using the auto tune panel

The Auto Tune panel should only be used if one or more of the following components have been changed:

- The Si4713 device.
- The Inductor connected to the TXO pin 4.
- The inline resistor connected to the TXO pin 4 (if fitted).
- The ESD diode package connected to the TXO pin 4 (if fitted).

This procedure follows the alignment that is done in the factory to ensure that the FMTx 2.1 solution is aligned to provide the correct Tx output power for the relevant legislations such as FCC and ETSI.

8 — System Module and User Interface

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Table of Contents

Introduction........8–5
    Phone description........8–5
Energy management........8–7
    Battery and charging........8–7
    Backup battery........8–7
    Normal and extreme voltages........8–8
    Power key and system power-up........8–8
    Power distribution........8–9
    Clocking scheme........8–10
Bluetooth and FM RDS radio module........8–11
GPS module........8–12
WLAN module........8–13
FM transmitter module........8–13
High-speed USB........8–13
CBUS interface........8–14
FBUS interface........8–14
ECI interface........8–14
USB charger interface........8–14
SIM interface........8–15
MicroSD card interface........8–16
Camera concept........8–16
    Camera concept........8–16
User interface........8–17
    User interface........8–17
    Display module........8–18
    I/O expander and keyboard........8–19
    Illumination........8–21
    Naviscroll........8–22
ASICs........8–23
    RAPIDOYAWE........8–23
    EM ASIC BETTY N2300........8–23
    EM ASIC VILMA N2200........8–23
Device memories........8–24
    Combo memory........8–24
Audio concept........8–24
    Audio HW architecture........8–24
    Internal microphone........8–25
    Internal earpiece........8–25
    Internal speakers........8–26
    Vibra circuitry........8–26
    Accessory AV connector........8–27
    External earpiece and microphone........8–28
Baseband technical specifications........8–29
    External interfaces........8–29
    SIM IF connections........8–29
    Charger connector and charging interface connections & electrical characteristics........8–29
    Internal interfaces........8–30
    Back-up battery interface electrical characteristics........8–30
RF technical description........8–31
    RF block diagram........8–31

Receiver (RX) 8–32
Transmitter (TX) 8–32
Frequency mappings 8–33
GSM850 frequencies 8–33
EGSM900 frequencies 8–33
GSM1800 frequencies 8–34
GSM1900 frequencies 8–36
WCDMA 2100 Rx frequencies 8–37
WCDMA 2100 Tx frequencies 8–38
WCDMA V (850) frequencies 8–39
WCDMA VIII (900) frequencies 8–40

List of Tables

Table 9 Nominal voltages 8–8
Table 10 Keyboard matrix 8–20
Table 11 Charging interface connections 8–30
Table 12 Charging IF electrical characteristics 8–30
Table 13 Back-up battery electrical characteristics 8–30

List of Figures

Figure 59 System module block diagram 8–6
Figure 60 Board and module connections 8–7
Figure 61 Power distribution 8–9
Figure 62 Clocking scheme 8–10
Figure 63 Bluetooth & FM radio block diagram 8–12
Figure 64 GPS module 8–12
Figure 65 WLAN module 8–13
Figure 66 FM transmitter 8–13
Figure 67 HS USB block diagram 8–14
Figure 68 USB charging interface block diagram 8–15
Figure 69 SIM interface 8–15
Figure 70 MicroSD card interface 8–16
Figure 71 Camera block diagram 8–17
Figure 72 User interface block diagram 8–18
Figure 73 Display interface block diagram 8–19
Figure 74 I/O expander and keyboard matrix 8–20
Figure 75 Illumination block diagram 8–21
Figure 76 Light segments 8–22
Figure 77 Block diagram of Naviscroll Interface 8–23
Figure 78 Audio system block 8–25
Figure 79 Internal microphone 8–25
Figure 80 Internal earpiece circuitry 8–26
Figure 81 Internal speakers 8–26
Figure 82 Vibra circuitry 8–26
Figure 83 Accessory (AV) connector 8–27
Figure 84 Accessory (AV) connector with DAC33 and TPA6130 audio enhancements 8–28
Figure 85 External earpiece and microphone audio circuit 8–28
Figure 86 Charger connector 8–29
Figure 87 RF block diagram RM-333 using RF ASIC N7500 8–31
Figure 88 RF block diagram RM-334 using RF ASIC N7500 8–32

Introduction

Phone description

RAPIDOYAWE is the main digital baseband ASIC in the HW53. It contains functionality for both WCDMA and GSM EDGE.

AVILMA is power management ASIC having voltage regulators and audio transceiver and BETTY is energy management ASIC having charging switch and FBUS transceiver.

Memory components are internal COMBO 1 Gb/2 Gb and a card reader for MicroSD.

Function	Description	Item ref
EM ASIC	AVILMA	N2200
	BETTY	N2300
System ASIC	RAPIDOYAWE	D2800
Memory	Combo 1Gb DDR + 2Gb M3	D3000
Camera accelerator	OMAP-DM500	N1400
Display controller	S1D13747	D2450
Back-up battery	RTC BACKUP CAPAC 311	G2200
FM-radio with RDS	BTHFMRDS2.1 module	D6000
Bluetooth	BTHFMRDS2.1 module	D6000
WLAN	WLAN module ENW49701N	N6300
GPS	GPS5350_ROM3.0	N6200
RF ASIC	Vapaus	N7500
GSM PA	850/900/1800/1900	N7520
WCDMA PA	850/900/1900/2100	N7540
Oscillator	VCTCXO 38.4MHZ	G7500
	TCXO 38.4 MHz	G6450
	Crystal 32.768KHZ	B2200
IO-expander	BASIC IOExpander	N2850
SIM card reader		X2700
HS USB transceiver	ISP1704	D3300
FM transmitter	SI4713	N6150
TV out graphics engine	S1D13771B	D2480
Naviscroll driver	QTC12C15	N2525
Accelerometer	AHTI_A 3-AXIS	N6501

System module block diagram

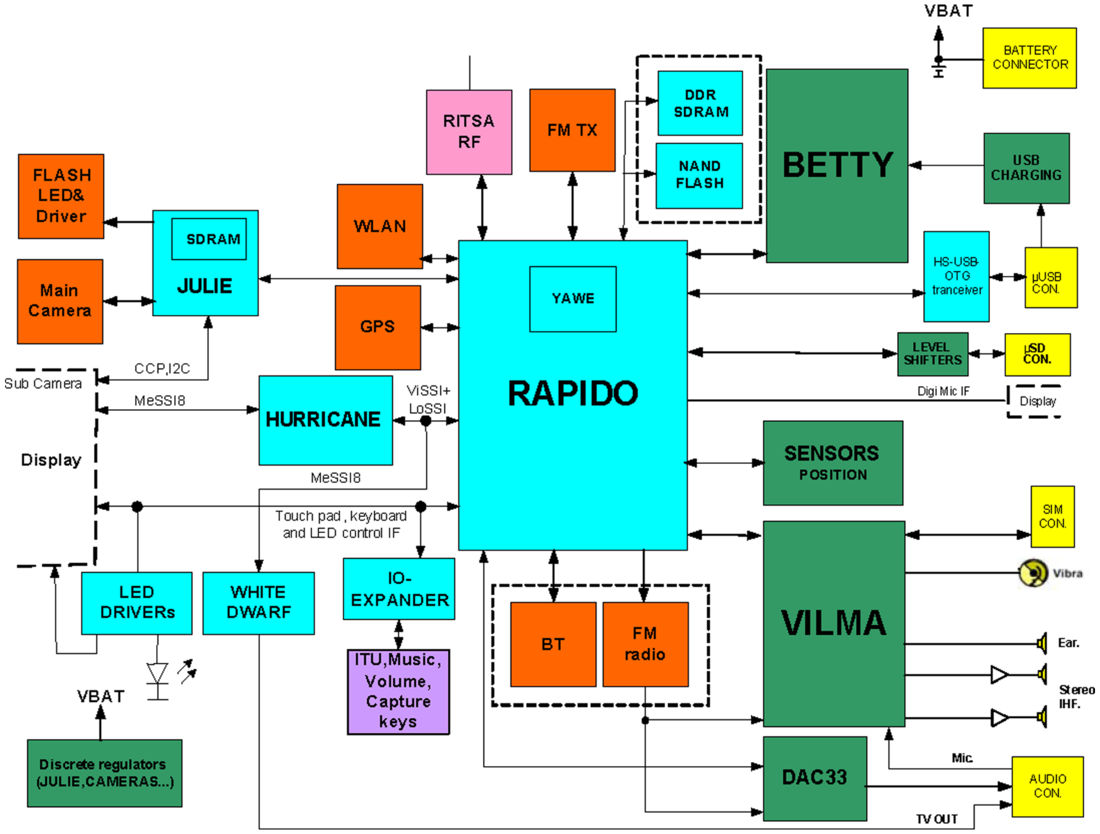
VBAT
BATTERY CONNECTOR
RITSA RF
FM TX
DDR SDRAM
NAND FLASH
BETTY
USB CHARGING
FLASH LED& Driver
SDRAM
JULIE
WLAN
Main Camera
GPS
YAWE
HS-USB-OTG tranceiver
µUSB CON.
LEVEL SHIFTERS
µSD CON.
RAPIDO
CCP,I2C
Sub Camera
MeSSI8
HURRICANE
ViSSI+ LoSSI
Digi Mic IF
Display
Display
MeSSI8
SENSORS POSITION
Touch pad , keyboard and LED control IF
SIM CON.
Vibra
LED DRIVERs
WHITE DWARF
IO-EXPANDER
VILMA
BT
FM radio
ITU,Music, Volume, Capture keys
Ear.
VBAT
Stereo IHF.
Mic.
Discrete regulators (JULIE,CAMERAS...)
DAC33
AUDIO CON.
TV OUT

Figure 59 System module block diagram

Board and module connections

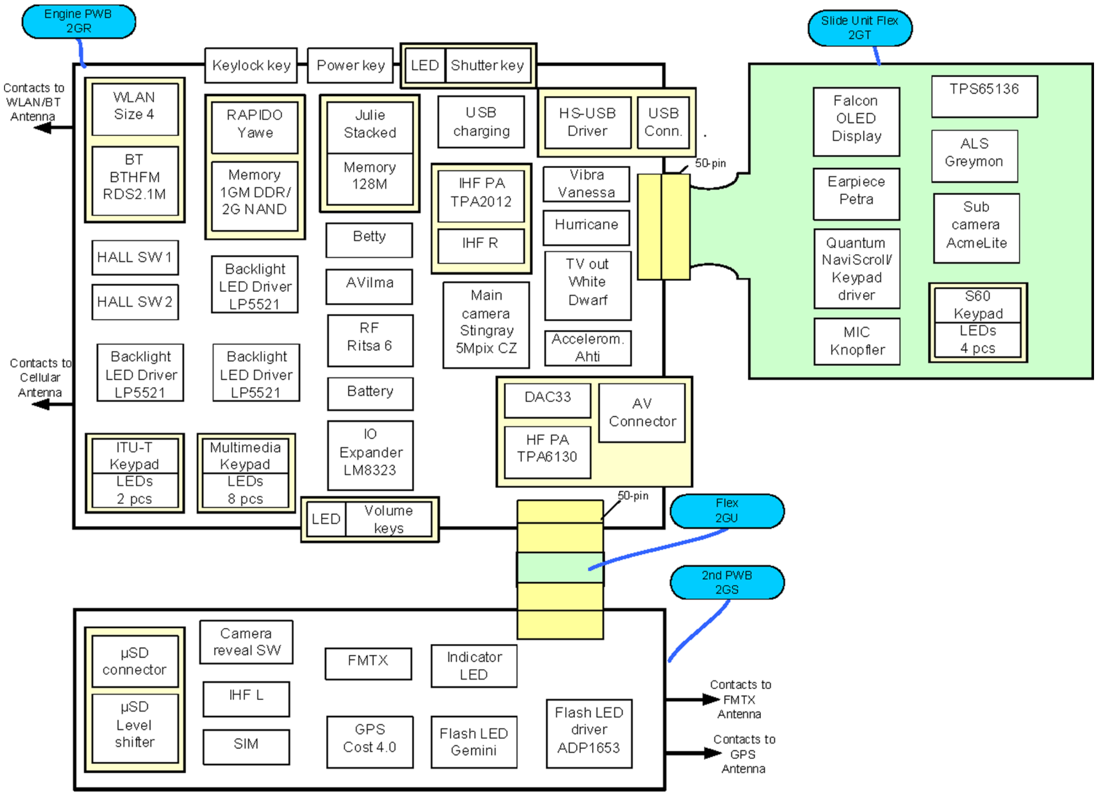
Engine PWB 2GR
Contacts to WLAN/BT Antenna
Keylock key
Power key
LED
Shutter key
WLAN Size 4
BT BTHFM RDS2.1M
RAPIDO Yawe
Memory 1GM DDR/ 2G NAND
Julie Stacked
Memory 128M
USB charging
HS-USB Driver
USB Conn.
IHF PA TPA2012
IHF R
Vibra Vanessa
Hurricane
TV out White Dwarf
Accelerom. Ahti
Betty
AVilma
RF Ritsa 6
Battery
IO Expander LM8323
Main camera Stingray 5Mpix CZ
HALL SW1
HALL SW2
Backlight LED Driver LP5521
Backlight LED Driver LP5521
Backlight LED Driver LP5521
Contacts to Cellular Antenna
ITU-T Keypad LEDs 2 pcs
Multimedia Keypad LEDs 8 pcs
LED
Volume keys
DAC33
HF PA TPA6130
AV Connector
50-pin
50-pin
Slide Unit Flex 2GT
Falcon OLED Display
Earpiece Petra
Quantum NaviScroll/ Keypad driver
MIC Knopfler
TPS65136
ALS Greymon
Sub camera AcmeLite
S60 Keypad LEDs 4 pcs
Flex 2GU
2nd PWB 2GS
µSD connector
µSD Level shifter
Camera reveal SW
IHF L
SIM
FMTX
GPS Cost 4.0
Indicator LED
Flash LED Gemini
Flash LED driver ADP1653
Contacts to FMTX Antenna
Contacts to GPS Antenna

Figure 60 Board and module connections

Energy management

Battery and charging

Battery

Supported battery type is BL-5K.

Battery connector

Blade battery connector type.

- VBAT (Battery voltage)
- BSI (Battery size indication)
- GND (Battery ground)

Charging

This phone is charged through the micro USB connector. The phone supports dedicated, host or hub chargers.

Charging is controlled by energy management, and external components are needed to protect the baseband module against EMC, reverse polarity and transient frequency deviation.

Backup battery

When the main battery is not attached EM ASIC (N2200) goes in backup mode using back-up battery that supplies voltage to RTC in EM ASIC (N2200).

Normal and extreme voltages

Energy management is mainly carried out in the two Application Specific Integrated Circuits (ASICs) BETTY and AVILMA. These two circuits contains a number of regulators. In addition there are some external regulators too.

In the table below normal and extreme voltages are shown when a BL-5K battery is used.

Table 9 Nominal voltages

Voltage	Voltage [V]	Condition
General Conditions		
Nominal voltage	3.700	
Lower extreme voltage	3.145	
Higher extreme voltage	4.230	
(fast charging)		
HW Shutdown Voltages		
Vmstr+	2.1 ± 0.1	Off to on
Vmstr-	1.9 ± 0.1	On to off
SW Shutdown Voltages		
Sw shutdown	3.15	In call
Sw shutdown	3.3	In idle
Min Operating Voltage		
Vcoff+	2.9 ± 0.1	Off to on
Vcoff-	2.6 ± 0.1	On to off

Power key and system power-up

When the battery is placed in the phone the power key circuits are energized. When the power key is pressed, the system boots up (if an adequate battery voltage is present).

Power down can be initiated by pressing the power key again (the system is powered down with the aid of SW). The power key is connected to EM ASIC N2200 (AVILMA) via PWRONX signal.

The power key may be disabled in certain charging cases.

Power distribution

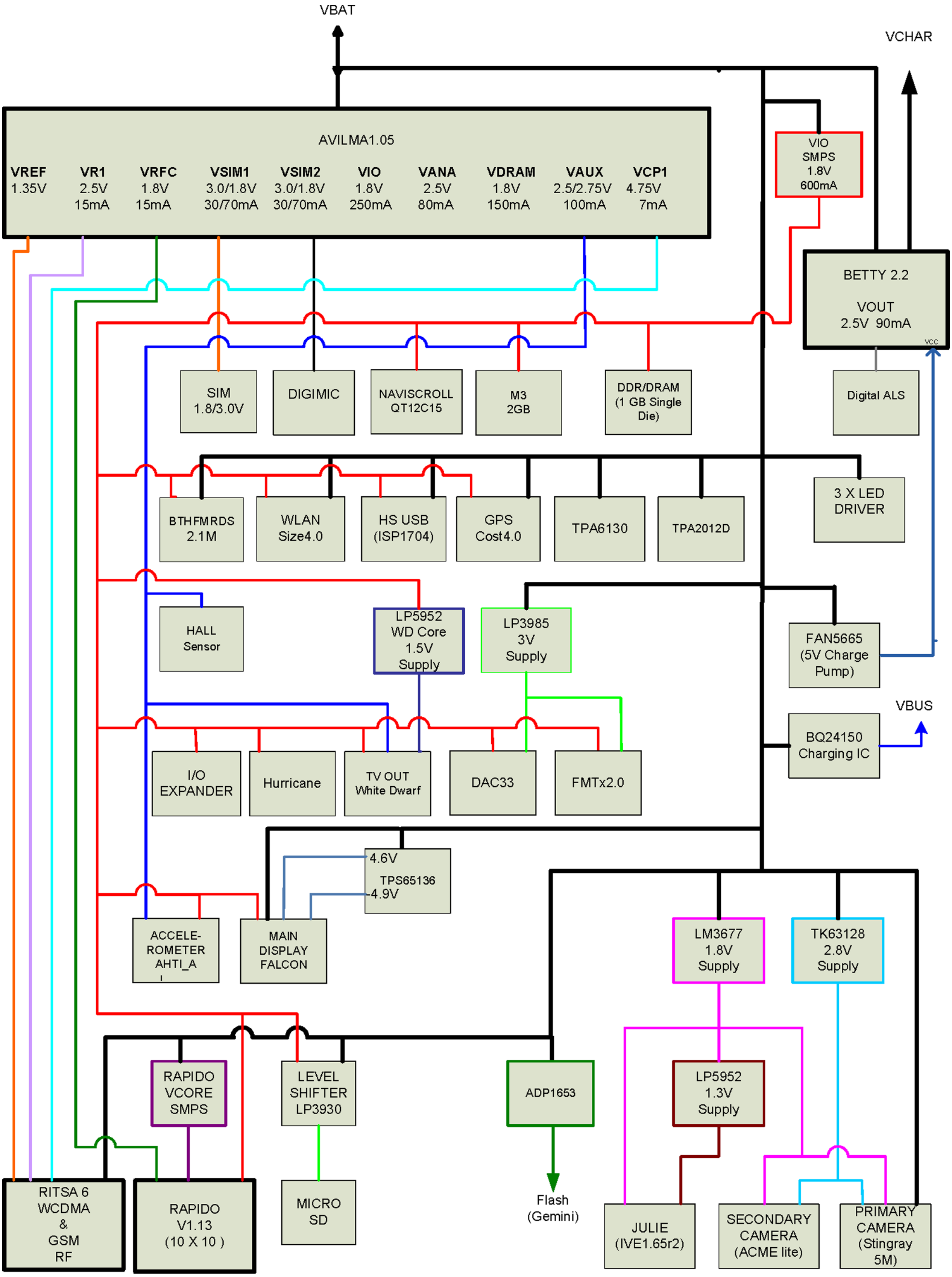
VBAT
VCHAR
AVILMA1.05
VREF 1.35V
VR1 2.5V 15mA
VRFC 1.8V 15mA
VSIM1 3.0/1.8V 30/70mA
VSIM2 3.0/1.8V 30/70mA
VIO 1.8V 250mA
VANA 2.5V 80mA
VDRAM 1.8V 150mA
VAUX 2.5/2.75V 100mA
VCP1 4.75V 7mA
VIO SMPS 1.8V 600mA
BETTY 2.2
VOUT 2.5V 90mA
VCC
Digital ALS
SIM 1.8/3.0V
DIGIMIC
NAVISCROLL QT12C15
M3 2GB
DDR/DRAM (1 GB Single Die)
BTHFMRDS 2.1M
WLAN Size4.0
HS USB (ISP1704)
GPS Cost4.0
TPA6130
TPA2012D
3 X LED DRIVER
HALL Sensor
LP5952 WD Core 1.5V Supply
LP3985 3V Supply
FAN5665 (5V Charge Pump)
VBUS
BQ24150 Charging IC
I/O EXPANDER
Hurricane
TV OUT White Dwarf
DAC33
FMTx2.0
4.6V
TPS65136
4.9V
ACCELE-ROMETER AHTI_A
MAIN DISPLAY FALCON
LM3677 1.8V Supply
TK63128 2.8V Supply
RAPIDO VCORE SMPS
LEVEL SHIFTER LP3930
ADP1653
LP5952 1.3V Supply
Flash (Gemini)
RITSA 6 WCDMA & GSM RF
RAPIDO V1.13 (10 X 10)
MICRO SD
JULIE (IVE1.65r2)
SECONDARY CAMERA (ACME lite)
PRIMARY CAMERA (Stingray 5M)

Figure 61 Power distribution

Clocking scheme

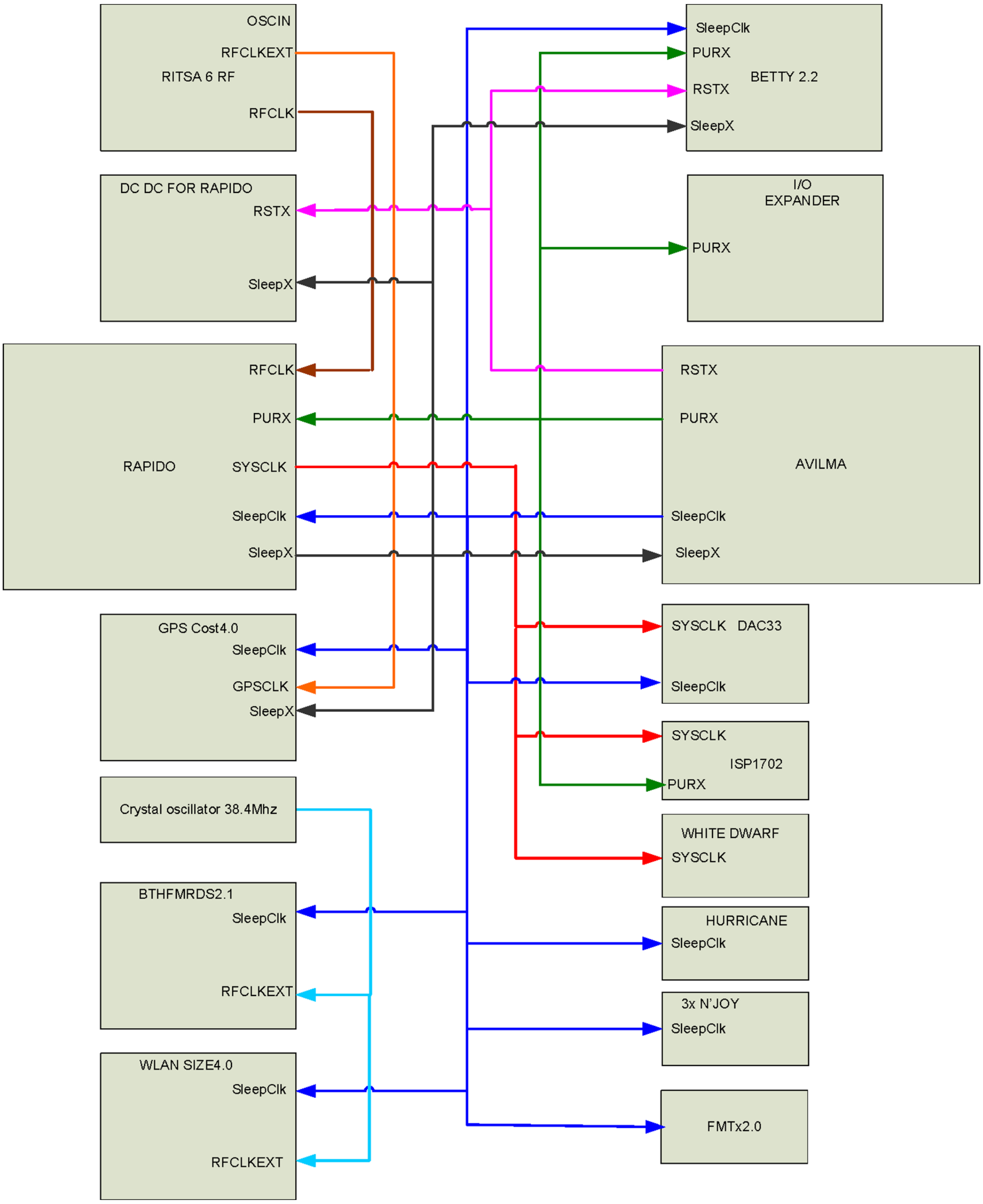
RITSA 6 RF
OSCIN
RFCLKEXT
RFCLK
DC DC FOR RAPIDO
RSTX
SleepX
RAPIDO
RFCLK
PURX
SYSCLK
SleepClk
SleepX
GPS Cost4.0
SleepClk
GPSCLK
SleepX
Crystal oscillator 38.4Mhz
BTHFMRDS2.1
SleepClk
RFCLKEXT
WLAN SIZE4.0
SleepClk
RFCLKEXT
BETTY 2.2
SleepClk
PURX
RSTX
SleepX
I/O EXPANDER
PURX
AVILMA
RSTX
PURX
SleepClk
SleepX
DAC33
SYSCLK
SleepClk
ISP1702
SYSCLK
PURX
WHITE DWARF
SYSCLK
HURRICANE
SleepClk
3x N'JOY
SleepClk
FMTx2.0

Figure 62 Clocking scheme

HW 53 engine clocks	
RFCLK	38.4 MHz
SleepClk	32.768kHz
RFCLKEXT	38.4 MHz
SYSCLK	19.2 MHz

Bluetooth and FM RDS radio module

Bluetooth and FM radio receiver are provided by the same ASIC (Broadcom BCM2048). The device supports Bluetooth operation and FM radio rececption in both European/USA and Japanese bands (the appropriate region-specific FM radio band is pre-configured in the phone software). The UART interface allows the device to communicate with the phone baseband engine using Bluetooth HCI commands. Commands to the FM radio can also be sent over the I2C interface.

When Bluetooth is switched on, the phone user interface the BT_RESETX line is toggled to reset the Bluetooth device, and commands are sent over the UART interface to configure the device. If UART communication fails (due to a hardware fault) it will not be possible to switch on Bluetooth from the phone user interface.

The device has two clock signals: SYS_CLK (19.2MHz, 26.0MHz, or 38.4MHz supported) and SLEEP_CLK (32.768kHz). The SLEEP_CLK is supplied all the time the phone is switched on. To maximise the phone standby time, it is only necessary to provide a SYS_CLK signal when Bluetooth activity occurs, such as sending Bluetooth data to another device, or checking periodically if there are any other Bluetooth devices attempting to communicate with it. At other times when the Bluetooth device is in standby mode or the FM radio is switched on it is only necessary to provide a SLEEP_CLK signal. The Bluetooth-FM ASIC is powered directly from the phone battery voltage line (VBAT). An internal regulator is enabled when Bluetooth or FM radio is switched on.

Bluetooth audio signals are sent to and from the device using a PCM interface. The Bluetooth RF signal is routed via a buried track to the Bluetooth antenna on the side of the PWB. An RF filter is needed between the Bluetooth antenna and Bluetooth ASIC to prevent interference to and from the celluar phone antenna. Phones that have both Bluetooth and WLAN use a shared antenna, as both services occupy the 2.4GHz ISM frequency band. The co-existence signaling interface between Bluetooth and WLAN ASICs controls the RF activity in the shared frequency band.

The audio signal from the FM radio is routed via the phone Audio ASIC to the phone headset or loudspeaker. The external wired headset is also used as an Antenna for the FM radio. The FM radio receiver RF signal is routed from the ASIC via a buried track to an impedance matching circuit placed near the headset connector.

The following block diagram shows how Bluetooth-FM is connected to the host engine.

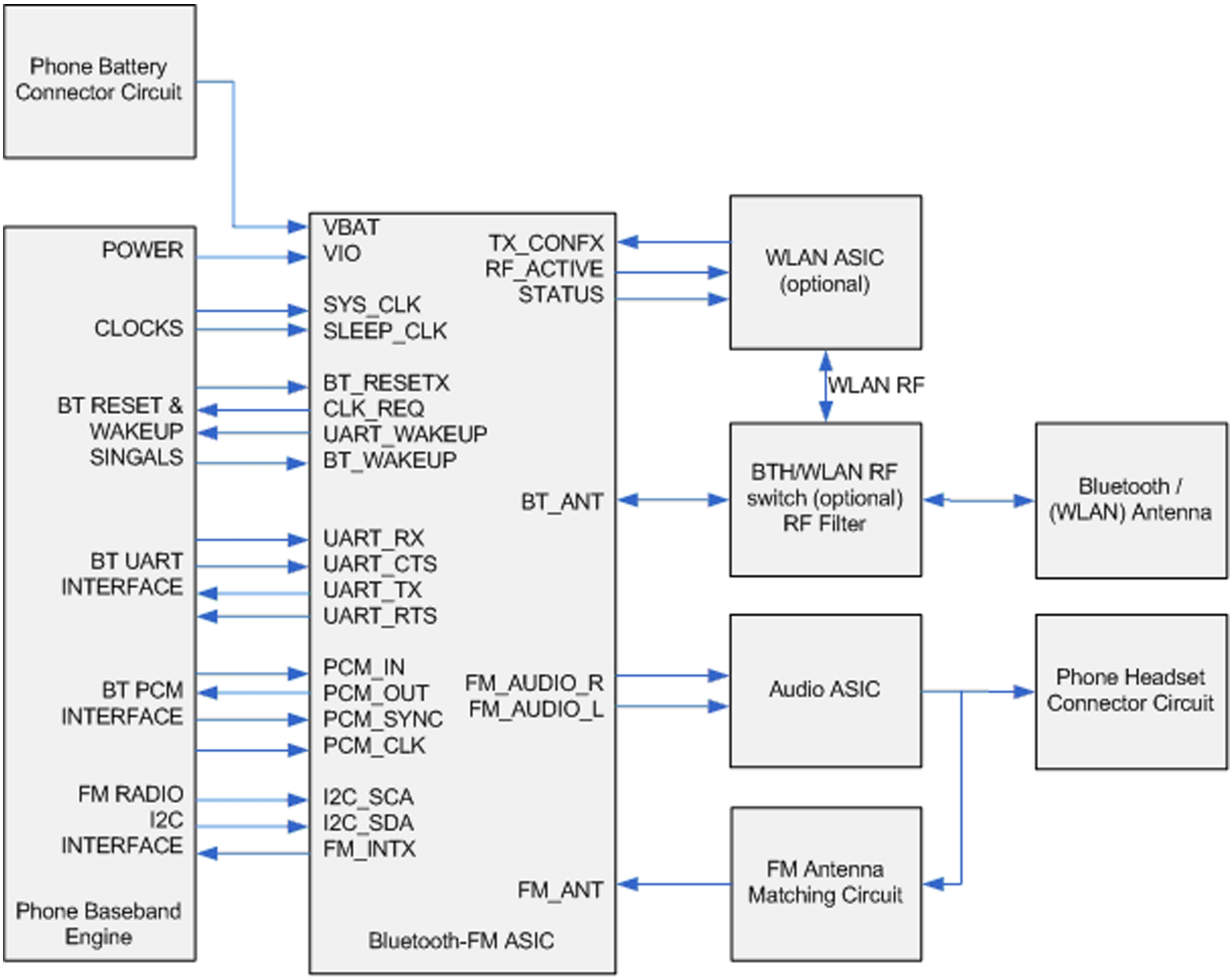
Phone Battery Connector Circuit
POWER
CLOCKS
BT RESET & WAKEUP SINGALS
BT UART INTERFACE
BT PCM INTERFACE
FM RADIO I2C INTERFACE
Phone Baseband Engine
VBAT
VIO
SYS_CLK
SLEEP_CLK
BT_RESETX
CLK_REQ
UART_WAKEUP
BT_WAKEUP
UART_RX
UART_CTS
UART_TX
UART_RTS
PCM_IN
PCM_OUT
PCM_SYNC
PCM_CLK
I2C_SCA
I2C_SDA
FM_INTX
TX_CONFX
RF_ACTIVE
STATUS
BT_ANT
FM_AUDIO_R
FM_AUDIO_L
FM_ANT
Bluetooth-FM ASIC
WLAN ASIC (optional)
WLAN RF
BTH/WLAN RF switch (optional) RF Filter
Bluetooth / (WLAN) Antenna
Audio ASIC
Phone Headset Connector Circuit
FM Antenna Matching Circuit

Figure 63 Bluetooth & FM radio block diagram

GPS module

HW53 supports GPSCost4.0 release. GPS module is connected to cellular engine via I2C interface and GenIO control signals. GPS clock configuration includes dedicated GPS TCXO and reference clock from Ahneus.

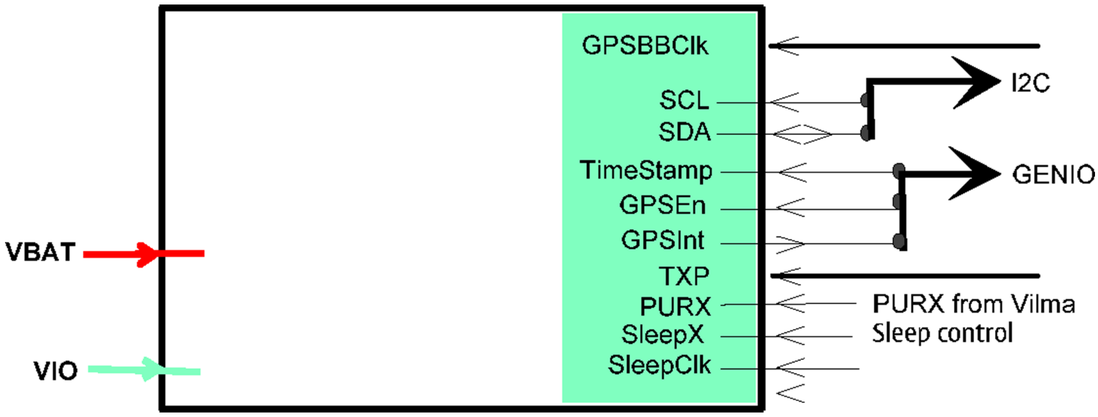
GPSBBClk
SCL
SDA
TimeStamp
GPSEn
GPSInt
TXP
PURX
SleepX
SleepClk
I2C
GENIO
PURX from Vilma
Sleep control
VBAT
VIO

Figure 64 GPS module

WLAN module

WLAN module HW53 supports WLANSize4.0 release. WLAN module is configured as Cellular engine SPI slave. WLAN and Bluetooth co-existence is supported via BTH-WLAN interface. WLANSize4.0 has a reference clock of external oscillator 38.4MHz and it is shared with BTHFMRDS2.1.

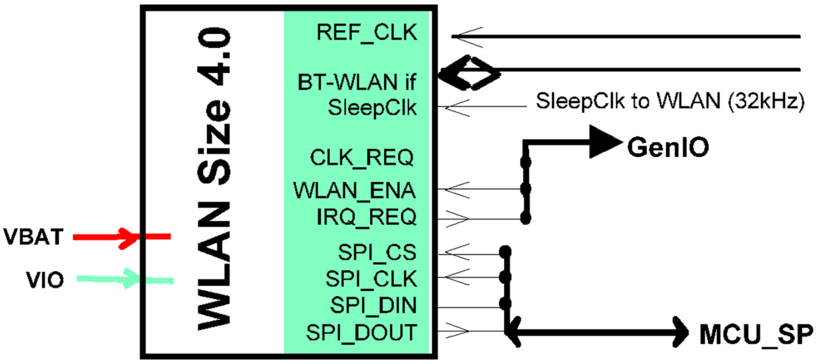
WLAN Size 4.0
REF_CLK
BT-WLAN if
SleepClk
CLK_REQ
WLAN_ENA
IRQ_REQ
SPI_CS
SPI_CLK
SPI_DIN
SPI_DOUT
SleepClk to WLAN (32kHz)
GenIO
MCU_SPI
VBAT
VIO

Figure 65 WLAN module

FM transmitter module

The FM transmitter module Si4713 is controlled by I2C from RAPIDO with left and right analog audio input from the DAC33.

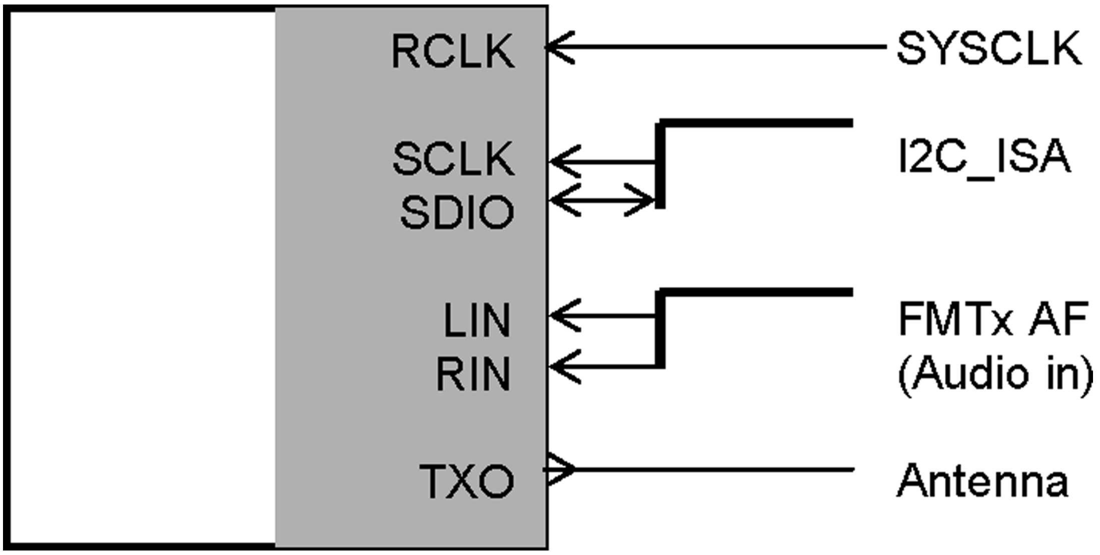
RCLK
SCLK
SDIO
LIN
RIN
TXO
SYSCLK
I2C_ISA
FMTx AF
(Audio in)
Antenna

Figure 66 FM transmitter

High-speed USB

High-speed USB

The device can transmit and receive USB data at high-speed (480 Mbit/s), full-speed (12 Mbit/s) and low-speed (1.5Mbit/s). The external interface is the micro-B connector X3300. The interface between D3300 USB transceiver and micro-B receptacle is the standard USB interface specified in the Universal Serial Bus specification Rev. 2.0. The USB transfers signal and power over four-wire interface, which carries differential data, Vbus and GND. Signalling occurs over differential data line D+ and D-. The clock is transmitted encoded along with the differential data. ESD protection is done with USB ASIP Z3300. VBUS (+5V) is provided by the host device. The circuit is protected from an overvoltage condition by transistor pair V3300 and reference zenner diode V3301.

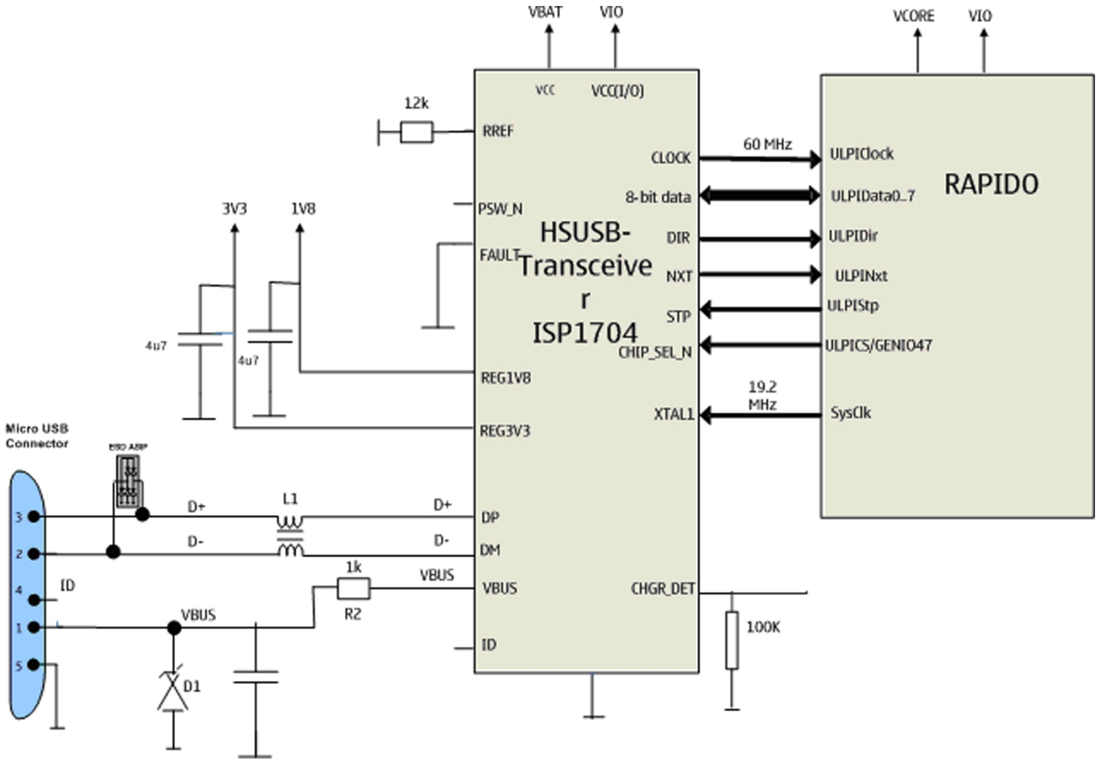
VBAT
VIO
VCORE
VIO
VCC
VCC(I/O)
12k
RREF
CLOCK
60 MHz
ULPIClock
8-bit data
ULPIData0..7
RAPIDO
PSW_N
HSUSB-
Transceive
r
ISP1704
DIR
ULPIDir
FAULT
NXT
ULPINxt
STP
ULPIStp
CHIP_SEL_N
ULPICS/GENIO47
3V3
1V8
4u7
4u7
REG1V8
19.2
MHz
XTAL1
SysClk
REG3V3
Micro USB
Connector
ESD ASIP
D+
L1
D+
DP
D-
D-
DM
1k
VBUS
VBUS
ID
R2
CHGR_DET
100K
VBUS
ID
D1
3
2
4
1
5

Figure 67 HS USB block diagram

CBUS interface

CBUS is a main system control bus in BB5. RAPIDO controls the functionality of EM ASICs AVilma (N2200) and Betty (N2300) with CBUS.

CBUS is a four-wire half-duplex master-slave interface. In HW53 CBUS clock frequency is 4.39 MHz.

FBUS interface

FBUS is a 2-wire serial communication bus between HW53 engine and service SW.

ECI interface

The ECI (Enhancement Control Interface) is a point-to-point, bi-directional, single line serial bus.

The purpose of the ECI is to identify and authenticate the accessory, and to act as a data bus (intended for control purposes) between the phone and the accessory .

USB charger interface

The main battery can be charged from the USB port. Default charging current level is 80 – 100 mA during the initial charging. Primary charging current level is up to 500 mA from USB Host and up to 1.25A from USB wall charger with external switch-mode USB Charger BQ24150.

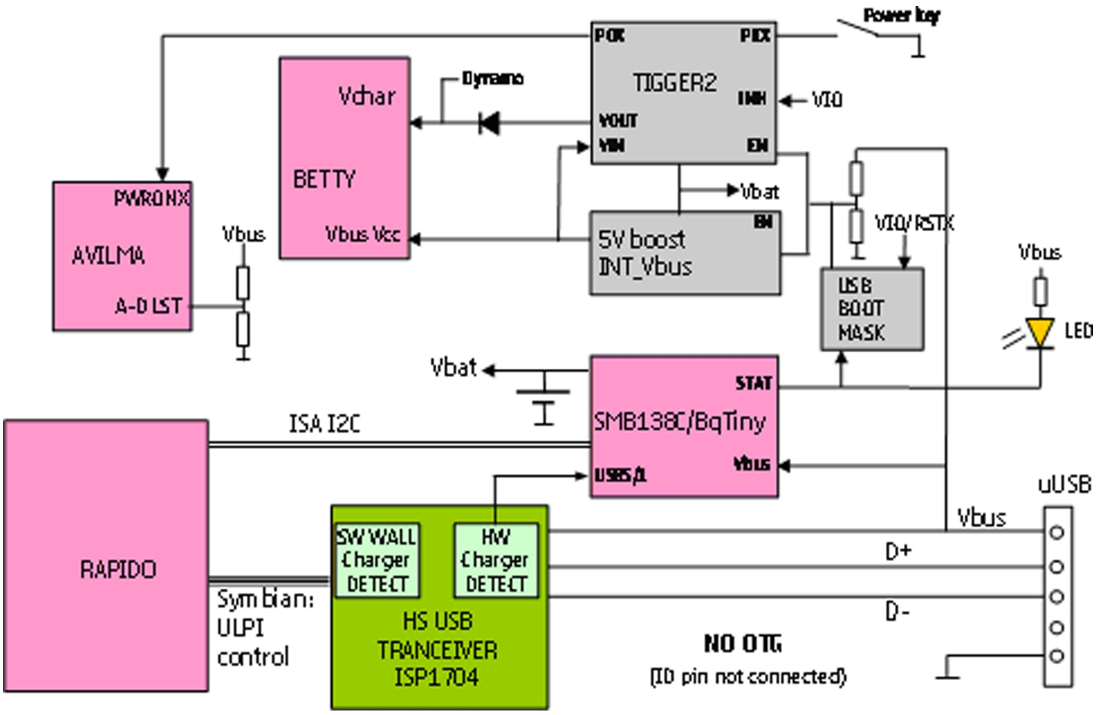
Power key
POR
PKX
TIGGER2
INH
VIO
VOUT
VIN
EN
Dynamo
Vchar
BETTY
Vbus Vcc
PWRONX
AVILMA
A-D LST
Vbus
Vbat
EN
5V boost
INT_Vbus
VIO/RSTX
USB
BOOT
MASK
Vbus
LED
Vbat
STAT
SMB138C/BqTiny
Vbus
USBSA
ISA I2C
RAPIDO
Symbian:
ULPI
control
SW WALL
Charger
DETECT
HW
Charger
DETECT
HS USB
TRANCEIVER
ISP1704
uUSB
Vbus
D+
D-
NO OTG
(ID pin not connected)

Figure 68 USB charging interface block diagram

SIM interface

The device has one SIM (Subscriber Identification Module) interface. It is only accessible if battery is removed. The SIM interface consists of an internal interface between RAPIDO and EM ASIC (N2200), and of an external interface between N2200 and SIM contacts.

The SIM IF is shown in the following figure:

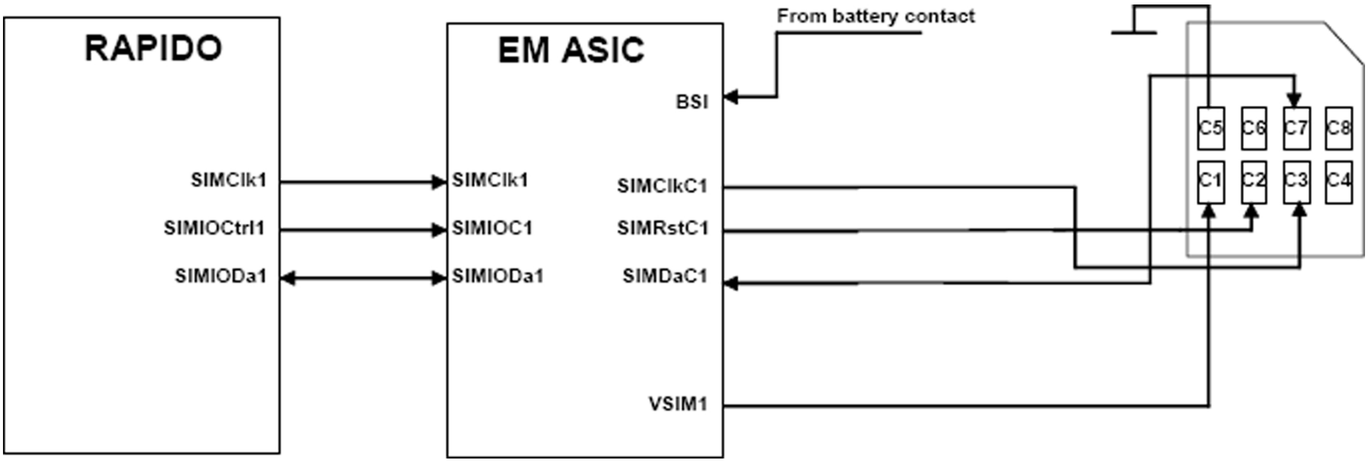
RAPIDO
SIMClk1
SIMIOCtrl1
SIMIODa1
EM ASIC
BSI
SIMClk1
SIMIOC1
SIMIODa1
SIMClkC1
SIMRstC1
SIMDaC1
VSIM1
From battery contact
C5
C6
C7
C8
C1
C2
C3
C4

Figure 69 SIM interface

The EM ASIC handles the detection of the SIM card. The detection method is based in the BSI line. Because of the location of the SIM card, removing the battery causes a quick power down of the SIM IF.

The EM ASIC SIM1 interface supports both 1.8 V and 3.0 V SIM cards. The SIM interface voltage is first 1.8 V when the SIM card is inserted, and if the card does not response to the ATR a 3 V interface voltage is used.

MicroSD card interface

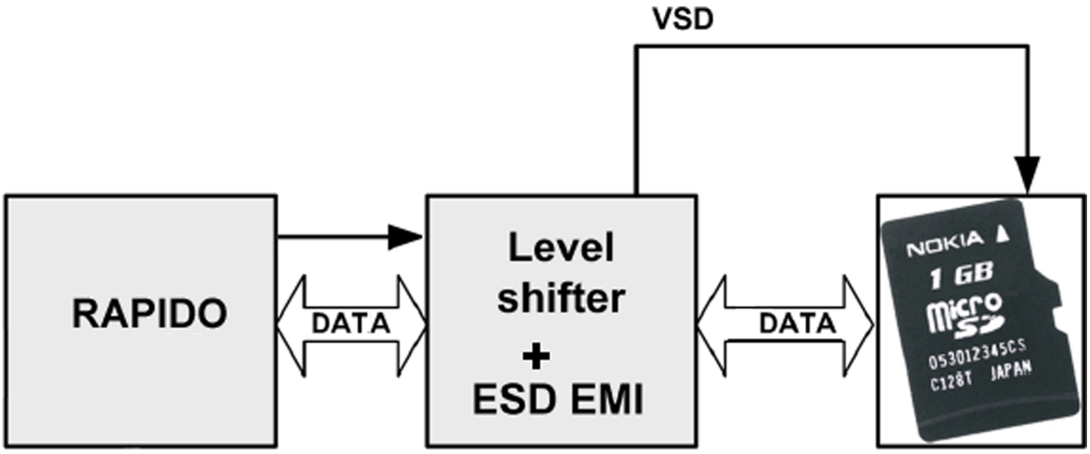
VSD
RAPIDO
DATA
Level
shifter
+
ESD EMI
DATA
NOKIA
1 GB
micro SD
053012345CS
C128T JAPAN

Figure 70 MicroSD card interface

The MicroSD card is connected to the engine by an external level shifter with an ESD protection filter. Supplied voltages:

- VSD: 2.85 V (from level shifter)
- VIO: 1.8 V (from VIO SMPS)

Hot swap is supported, which means that the card may be plugged in/out at any time, without removing the battery.

Camera concept

Camera concept

The camera is supported by DM299 (N1400) Camera accelerator, which is used for image and video processing. DM-299 uses 64Mbit discrete SDRAM. The camera module includes 3MPix main camera, CIF+ secondary camera, Flash LED and TPS61052 LED driver which are connected to DM-299.

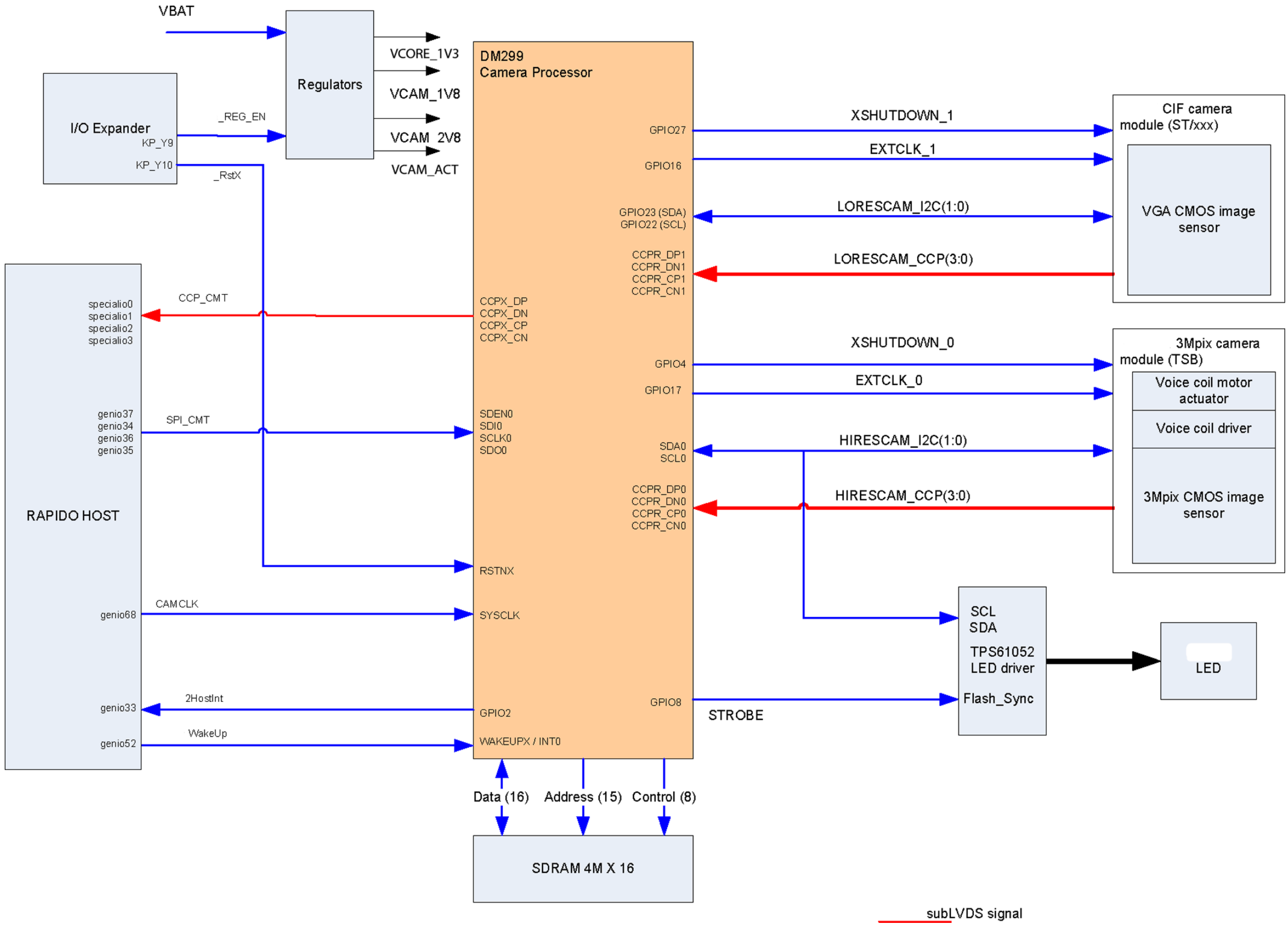
VBAT
Regulators
VCORE_1V3
VCAM_1V8
VCAM_2V8
VCAM_ACT
I/O Expander
_REG_EN
KP_Y9
KP_Y10
_RstX
DM299
Camera Processor
GPIO27
GPIO16
GPIO23 (SDA)
GPIO22 (SCL)
CCPR_DP1
CCPR_DN1
CCPR_CP1
CCPR_CN1
CCPX_DP
CCPX_DN
CCPX_CP
CCPX_CN
GPIO4
GPIO17
SDEN0
SDI0
SCLK0
SDO0
SDA0
SCL0
CCPR_DP0
CCPR_DN0
CCPR_CP0
CCPR_CN0
RSTNX
SYSCLK
GPIO2
GPIO8
WAKEUPX / INT0
XSHUTDOWN_1
EXTCLK_1
LORESCAM_I2C(1:0)
LORESCAM_CCP(3:0)
CIF camera module (ST/xxx)
VGA CMOS image sensor
XSHUTDOWN_0
EXTCLK_0
HIRESCAM_I2C(1:0)
HIRESCAM_CCP(3:0)
3Mpix camera module (TSB)
Voice coil motor actuator
Voice coil driver
3Mpix CMOS image sensor
RAPIDO HOST
specialio0
specialio1
specialio2
specialio3
CCP_CMT
genio37
genio34
genio36
genio35
SPI_CMT
CAMCLK
genio68
2HostInt
genio33
WakeUp
genio52
SCL
SDA
TPS61052
LED driver
Flash_Sync
STROBE
LED
Data (16)
Address (15)
Control (8)
SDRAM 4M X 16
subLVDS signal

Figure 71 Camera block diagram

User interface

User interface

The UI module contains the following main features:

- ITU keypad and five-way cursor control and dedicated multimedia key implemented on a standard cross-point matrix
- Finger position sensing keys for functions not part of the ITU matrix
- Finger position sensing beneath the five-way cursor control for the implementation of scrolling features in the UI
- The handset microphone and one of the IHF speakers
- Various independently controlled lighting zones for the UI features described above

The cross-point matrix, LEDs, microphone and IHF are connected to the handset engine using the I/O expander described below, and the finger position sensing controller is connected via an I2C bus.

A block diagram of the UI module is shown below. For clarity, the filtering components are not shown.

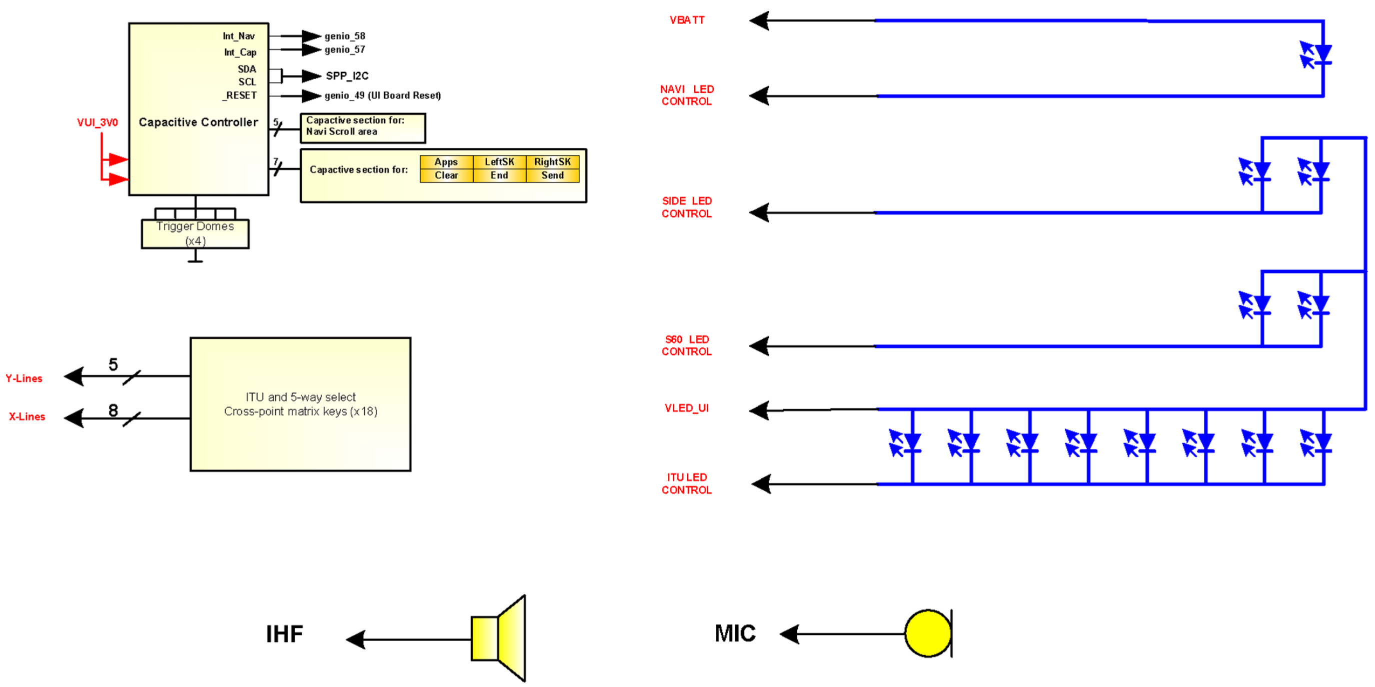
Int_Nav
Int_Cap
SDA
SCL
_RESET
genio_58
genio_57
SPP_I2C
genio_49 (UI Board Reset)
VUI_3V0
Capacitive Controller
5
Capactive section for:
Navi Scroll area
7
Capactive section for:
Apps
Clear
LeftSK
End
RightSK
Send
Trigger Domes
(x4)
Y-Lines
5
X-Lines
8
ITU and 5-way select
Cross-point matrix keys (x18)
VBATT
NAVI LED
CONTROL
SIDE LED
CONTROL
S60 LED
CONTROL
VLED_UI
ITU LED
CONTROL
IHF
MIC

Figure 72 User interface block diagram

The interface to the UI capacitive sensing controller is at 3.0V, which is provided from the engine by a dedicated linear regulator, and a dedicated level shifter provides the interface to allow the otherwise 1.8V logic levels of the engine to be used on the UI.

The capacitive sensors function by sensing changes in the the charge coupled from one electrode to another when the users finger is placed close to the electrodes patterns. There are further mechanical domes associated with this sensing arrangement which only allows the scanning of the charge transfer to occur when the user presses down on the front of the UI module – this is intended to prevent false key-activations.

Due to the construction of the module (it is mostly glued together) service is not possible, and if faultly, must be replaced. This includes any faults that are found in the internal microphone or the lower of the two IHF speakers.

For operational reasons, the modules are supplied unlocalised, and the correct localization front-panel needs to be attached after the 'bare' module has been installed in the handset.

Display module

Display features

- 2.6" AM OLED QVGA display (240 columns x 320 rows) supports up to 16.7M colors
- Ambient Light Sensor to optimize display brightness and power consumption

Display interface

Figure *Display interface block diagram* below shows how the display related signals are routed. Hurricane display HWA controlling is done via LoSSI bus and pixel data is transferred via ViSSI-12 bus. MeSSI-8 is the interface between Hurricane display HWA and Falcon OLED display.

As Falcon is self-emissive AM OLED display, no LED driver based backlighting is needed. An external DC-DC convertor TPS65136 is used for the display powering.

Supply voltages for Falcon display:

1 VIO from the baseband SMPS (1.8V)

2 VBAT from Battery(3.7V)

3 ELVDD supply from external DC/DC converter TPS65136 (+4.6V)

4 ELVSS supply from external DC/DC converter TPS65136 (-4.9V)

EL_ON signal from Falcon display is enable for the DC/DC converter TPS65136.

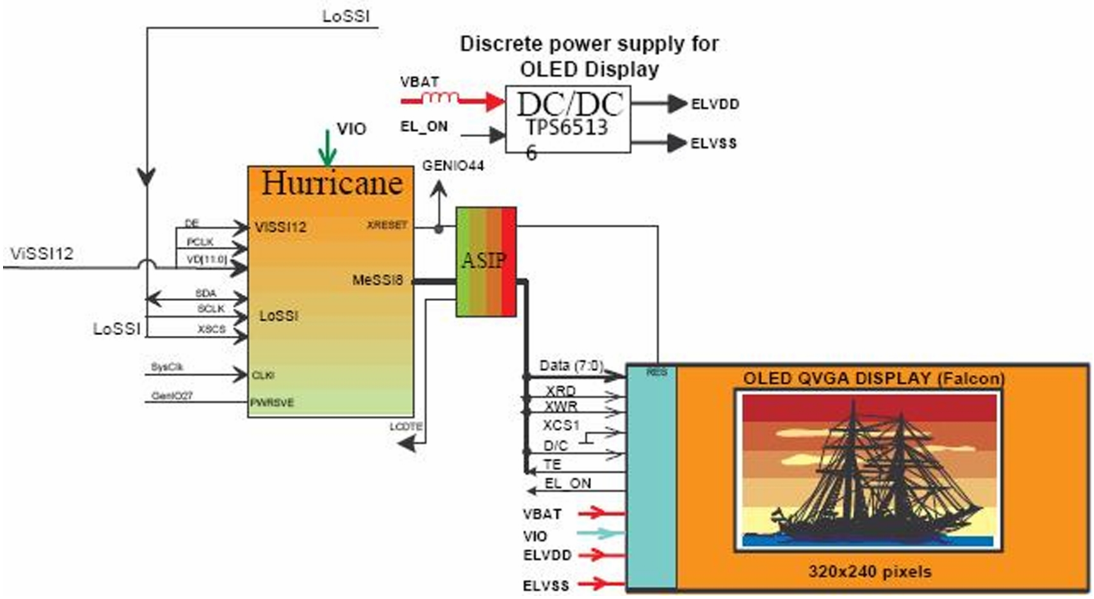
LoSSI
Discrete power supply for
OLED Display
VBAT
EL_ON
DC/DC
TPS6513
6
ELVDD
ELVSS
VIO
GENIO44
Hurricane
ViSSI12
DE
PCLK
VD[11:0]
VISSI12
XRESET
MeSSI8
ASIP
SDA
SCLK
XSCS
LoSSI
LoSSI
SysClk
CLKI
GenIO27
PWRSVE
LCDTE
Data (7:0)
RES
XRD
XWR
XCS1
D/C
TE
EL_ON
VBAT
VIO
ELVDD
ELVSS
OLED QVGA DISPLAY (Falcon)
320x240 pixels

Figure 73 Display interface block diagram

I/O expander and keyboard

HW53 supports LM8323 I/O Expander. I/O expander is connected to Rapido via I2C bus and Genio66 is used as an I/O Expander interrupt pin. Keyboard matrix 6x4 is connected to I/O expander. In addition, the I/O expander has general purpose IO's. Camera accelerator RSTX and Regulator enable, TVout Accelarator reset and Regulator enable are connected to I/O expander GPIO's.

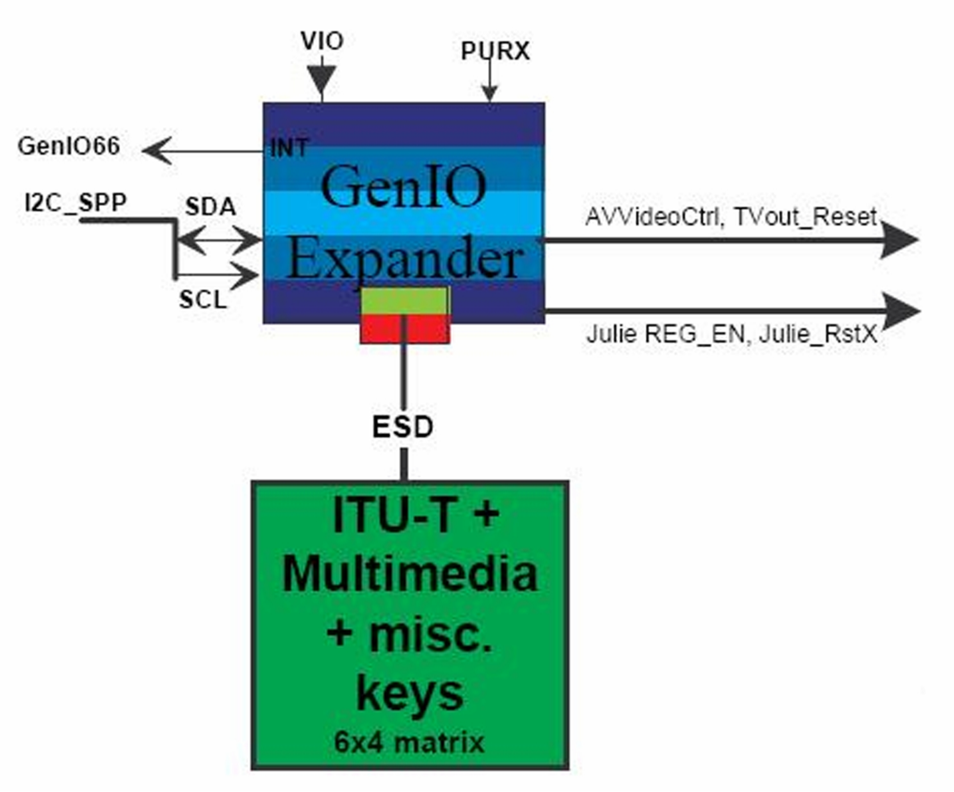
VIO
PURX
GenIO66
INT
I2C_SPP
SDA
SCL
GenIO Expander
AVVideoCtrl, TVout_Reset
Julie REG_EN, Julie_RstX
ESD
ITU-T + Multimedia + misc. keys
6x4 matrix

Figure 74 I/O expander and keyboard matrix

RM-333 has three separate keyboards:

- ITU keyboard
- Multimedia Keyboard
- S60 keyboard

ITU keyboard is visible when the slider is moved upwards. ITU keypads are located on the system/RF module. System/RF module includes also side keys (volume keys, 2-position capture key and keylock switch) and MM dome switches. MM keyboard is visible when the slider is moved downwards. S60 keys are located on UI/slide module. They are connected as 3x4 key matrix to the Naviscroll driver which operates like I/O Expander. More detailed description of S60 keyboard can be found in chapter *Naviscroll technical description*.

Table 10 Keyboard matrix

Expander's PINS		KP-Y0	KP-Y1	KP-Y2	KP-Y3
	Lines	COL0	COL1	COL2	COL3
KP-X0	ROW0	1	6	2	Vol Up
KP-X1	ROW1	5	9	#	Vol Down
KP-X2	ROW2	3	0	8	Capture half
KP-X3	ROW3	*	7	4	Capture full
KP-X4	ROW4	MM1	MM2	MM3	MM4
KP-X5	ROW5	Keylock			

Illumination

LED driver solution

Three LP5521 'NJOY LED drivers are used to supply power for different light segments. Each LED driver has three independently programmable constant current outputs (R, G and B). LED drivers are controlled by Rapido via ISA_I2C bus and they use 32kHz external clock from Vilma.

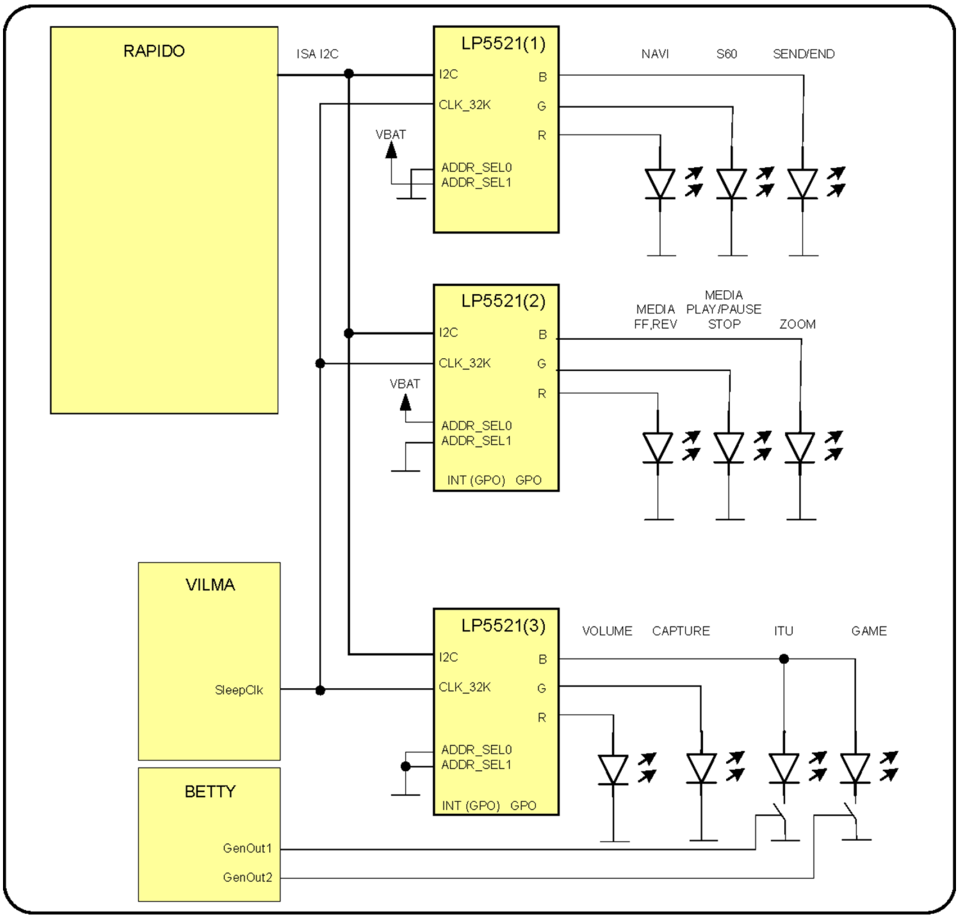
RAPIDO
ISA I2C
LP5521(1)
I2C
CLK_32K
VBAT
ADDR_SEL0
ADDR_SEL1
B
G
R
NAVI
S60
SEND/END
LP5521(2)
I2C
CLK_32K
VBAT
ADDR_SEL0
ADDR_SEL1
INT (GPO) GPO
B
G
R
MEDIA FF,REV
MEDIA PLAY/PAUSE STOP
ZOOM
VILMA
SleepClk
LP5521(3)
I2C
CLK_32K
ADDR_SEL0
ADDR_SEL1
INT (GPO) GPO
B
G
R
VOLUME
CAPTURE
ITU
GAME
BETTY
GenOut1
GenOut2

Figure 75 Illumination block diagram

Light segments

9+1 different light segments are used for illumination, each having 1-4 parallel connected LEDs (see Figure 2). ITU and Game light segments are connected to the same LED driver output. Betty controls them via GenOut1 and GenOut2 outputs (see Figure 1). Parallel connected LEDs which are in same LED driver output branch have serial resistor to even their currents. As ITU keyboard backlights are controlled by the Ambient Light Sensor (ALS) they are turned ON only in dark ambient light.

RM-333 has a self-emissive AM OLED display, therefore it does not need LEDs for backlighting

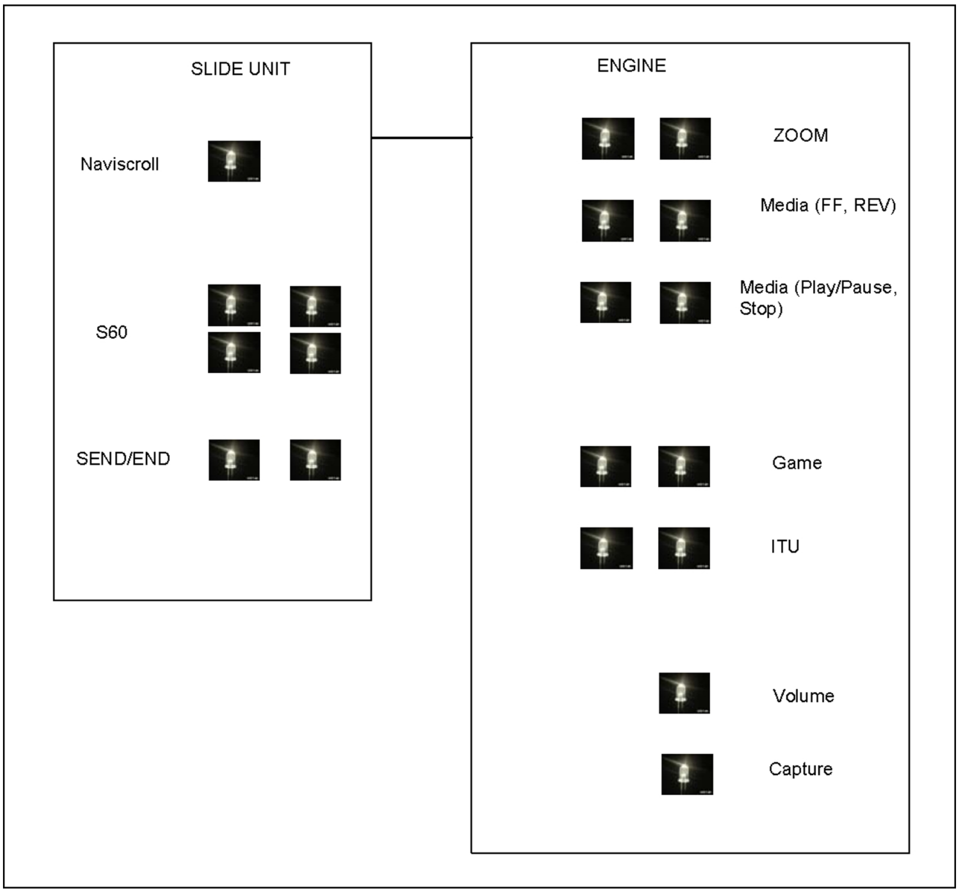

Figure 76 Light segments

Naviscroll

HW53 uses Quantum QT12C15 as Naviscroll Driver. As shown in Figure 1, it is interfaced to RAPIDO via SPP I2C bus for control and data, two change lines TouchPadInt and KeyInt used by Naviscroll Driver to report to RAPIDO any changes in the touchpad state or changes in the S60 key states, Rst is used as a reset signal from RAPIDO to Naviscroll Driver.

On the other side, Naviscroll Driver interfaces Naviscroll touchpad and S60 keys as 3x4 matrix. When there is a change in the touchpad state i.e. when the finger is scrolled over the naviscroll touchpad the Naviscroll Driver gives an interrupt to RAPIDO via TouchPadInt line by pulling it low. Similarly when any of the S60 keys is pressed the Naviscroll Driver gives an interrupt to RAPIDO via KeyInt line by pulling it low. When receiving either of the Interrupts, RAPIDO performs an I2C data read from Naviscroll Driver internal registers to determine Naviscroll touchpad XY position change if TouchPadInt was detected and to determine which S60 keys were pressed if KeyInt was detected. After that, the interrupt lines change state from low to high. 2V8 voltage regulator located on the UI flex supplies power for the Naviscroll driver.

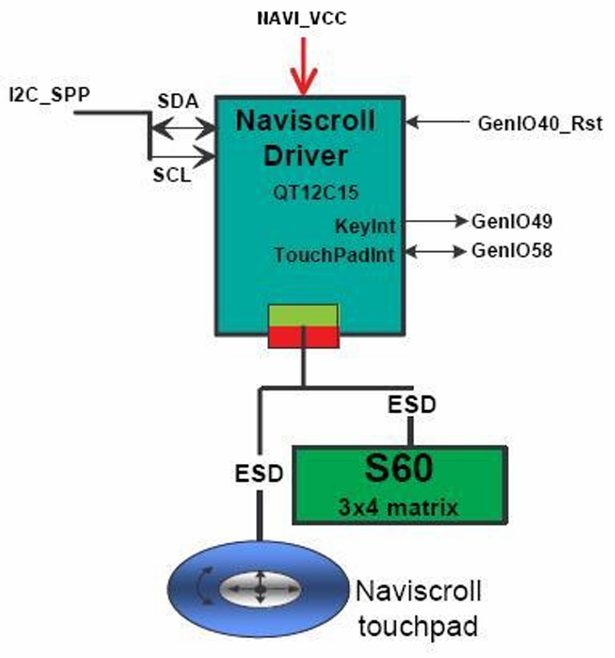
NAVI_VCC
I2C_SPP
SDA
SCL
Naviscroll Driver
QT12C15
KeyInt
TouchPadInt
GenIO40_Rst
GenIO49
GenIO58
ESD
ESD
S60
3x4 matrix
Naviscroll touchpad

Figure 77 Block diagram of Naviscroll Interface

ASICs

RAPIDOYAWE

RAPIDOYAWE ASIC (D2800) is a die-stacked Processor (RAPIDO) with 3G HDSPA logic (YAWE). RAM memory is integrated into RAPIDO.

EM ASIC BETTY N2300

The EM ASIC (N2300) includes the following functional blocks:

- Core supply generation
- Charge control circuitry
- Level shifter and regulator for USB/FBUS
- Current gauge for battery current measuring
- LED control for display backlighting
- Digital interface (CBUS)

EM ASIC VILMA N2200

The EM ASIC (N2200) includes the following functional blocks:

- Start up logic and reset control
- Charger detection
- Battery voltage monitoring
- 32.768kHz clock with external crystal
- Real time clock with external backup battery
- SIM card interface
- Stereo audio codecs and amplifiers
- A/D converter

- Regulators
- Vibra interface
- Digital interface (CBUS)

EMC ASIP (Appcation Specified Integrated Passive) have been integrated inside the ASIC. It includes biasing passives for microphone , EMC filter for SIM, microphones etc.

Device memories

Combo memory

The memory of the device consists of stacked DDR SDRAM and MuxedMassMemory (M3). Combo memory DDR/ M3 memory has 768Mb DDR + 2Gb M3.

Audio concept

Audio HW architecture

The functional core of the audio hardware is built around three ASICs: RAPIDOYAWE engine ASIC, mixed signal ASIC Avilma and D/A converter DAC33.

DAC33 converts digital audio signal to analog and is routed to the FM Transmitter and amplifier TPA6130 which provides an interface for the transducers and the accessory connector.

AVilma provides analog signal for earpiece and for D-class audio amplifier TPA2012D2, which drives integrated stereo handsfree speakers.

There are four audio transducers:

- 8x12 mm dynamic earpiece
- Two 8x12 mm dynamic speakers
- Digital MEMS (microelectromechanical systems) microphone

Avilma provides an output for the dynamic vibra component. All wired audio accessories are connected to the AV accessory connector. A Bluetooth audio and FM radio module, which is connected to RAPIDOYAWE, supports Bluetooth audio and FM radio functionality.

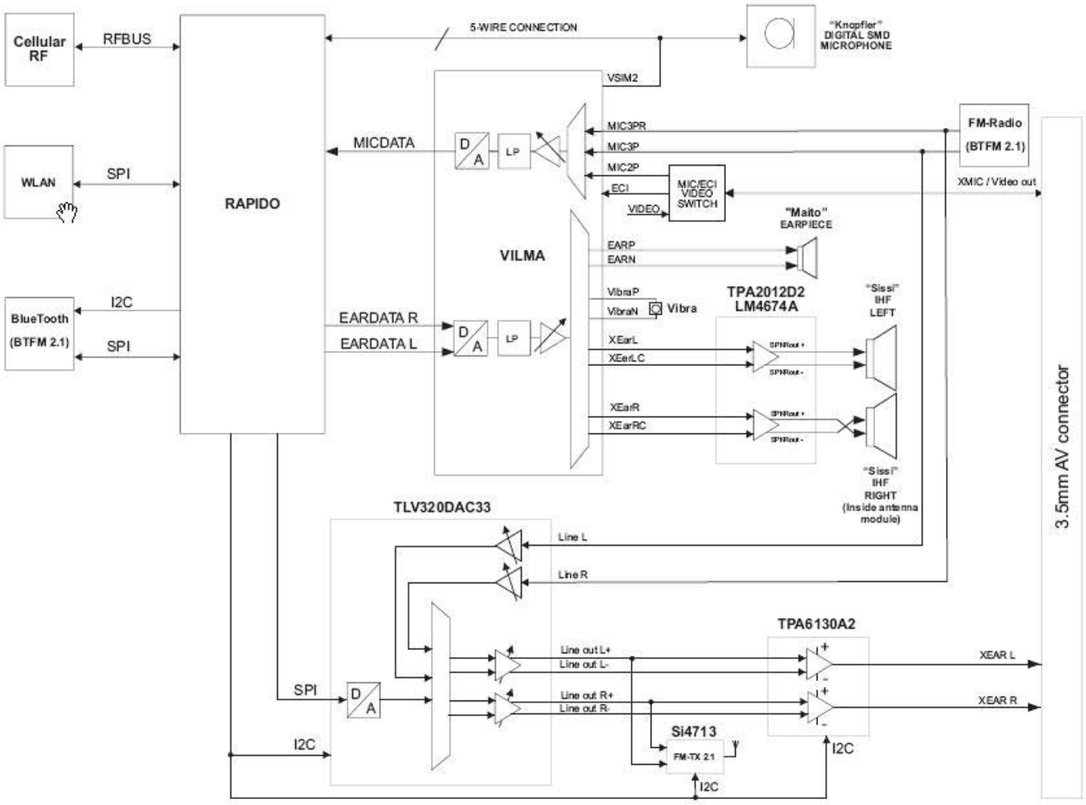
Cellular RF
RFBUS
WLAN
SPI
BlueTooth (BTFM 2.1)
I2C
SPI
RAPIDO
5-WIRE CONNECTION
"Knopfler" DIGITAL SMD MICROPHONE
VSIM2
MICDATA
D A
LP
MIC3PR
MIC3P
MIC2P
ECI
VIDEO
MIC/ECI VIDEO SWITCH
FM-Radio (BTFM 2.1)
XMIC / Video out
"Maito" EARPIECE
VILMA
EARP
EARN
VibraP
VibraN
Vibra
TPA2012D2 LM4674A
"Sissi" IHF LEFT
EARDATA R
EARDATA L
XEarL
XEarLC
XEarR
XEarRC
SPKRout+
SPKRout-
"Sissi" IHF RIGHT (Inside antenna module)
3.5mm AV connector
TLV320DAC33
Line L
Line R
TPA6130A2
Line out L+
Line out L-
Line out R+
Line out R-
XEAR L
XEAR R
SPI
I2C
Si4713
FM-TX 2.1
I2C
I2C

Figure 78 Audio system block

Internal microphone

The internal microphone is used for HandPortable (HP) and Internal HandsFree (IHF) call modes. A digital MEMS microphone data and clock line are connected to Rapidoyawe and operating voltage is received from Avilma.

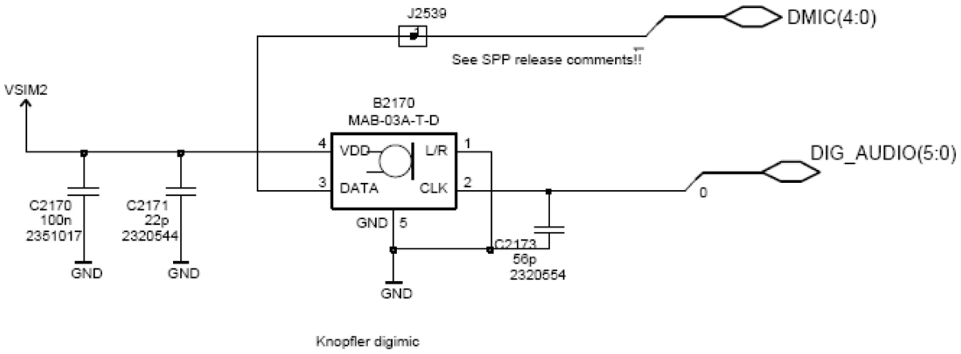
J2539
DMIC(4:0)
See SPP release comments!!
VSIM2
B2170
MAB-03A-T-D
VDD
L/R
DATA
CLK
GND
4
3
1
2
5
C2170 100n 2351017
C2171 22p 2320544
GND
GND
GND
C2173 56p 2320554
DIG_AUDIO(5:0)
0
Knopfler digimic

Figure 79 Internal microphone

Internal earpiece

Internal earpiece is used for the HandPortable (HP) call mode. A dynamic 8x12 mm earpiece capsule is Connected to Avilma ASIC's differential output EarP and EarN.

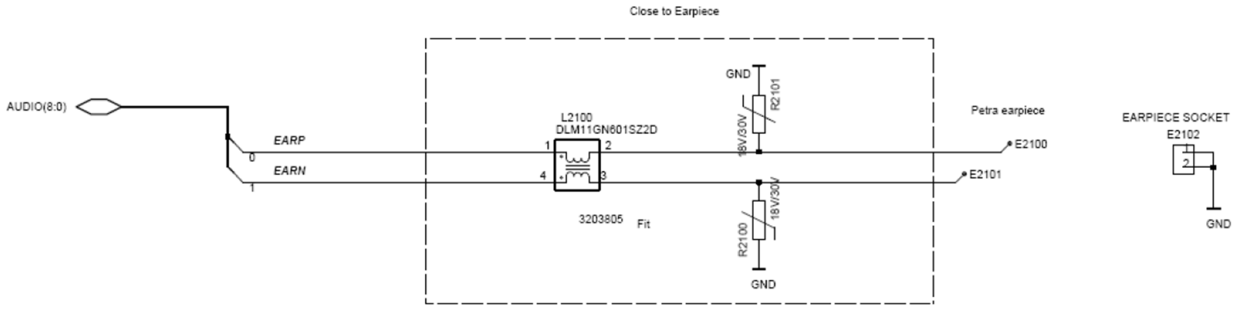
Close to Earpiece
AUDIO(8:0)
EARP
EARN
0
1
L2100
DLM11GN601SZ2D
1
2
4
3
3203805
Fit
GND
R2101
18V/30V
R2100
18V/30V
GND
Petra earpiece
E2100
E2101
EARPIECE SOCKET
E2102
1
2
GND

Figure 80 Internal earpiece circuitry

Internal speakers

Internal speakers are used for Internal HandsFree (IHF) call mode, video call, ringing tones, FM radio and music listening.

Two dynamic 8x12mm speakers are connected to Avilma ASIC's outputs XearR/XearL via stereo D-class IHF amplifier TPA2012D2. The amplifier has 12 dB fixed gain and it is put to shutdown mode when not in use.

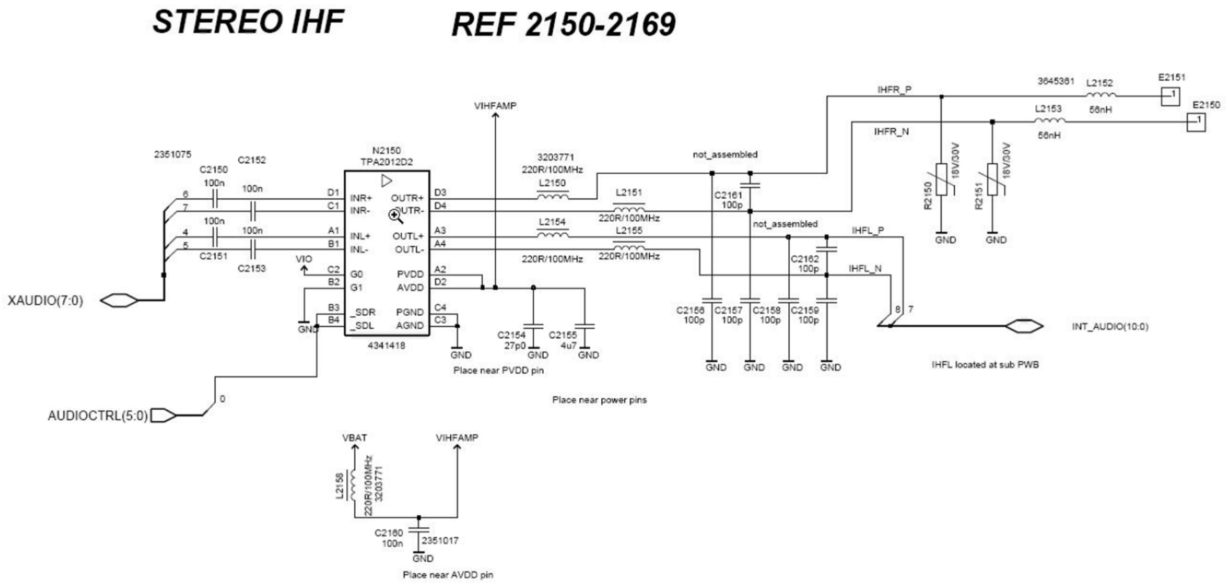
STEREO IHF
REF 2150-2169
2351075
C2150
100n
C2152
100n
100n
100n
C2151
C2153
6
7
4
5
XAUDIO(7:0)
AUDIOCTRL(5:0)
0
VIO
GND
N2150
TPA2012D2
D1
C1
A1
B1
C2
B2
B3
B4
INR+
INR-
INL+
INL-
G0
G1
_SDR
_SDL
OUTR+
OUTR-
OUTL+
OUTL-
PVDD
AVDD
PGND
AGND
D3
D4
A3
A4
A2
D2
C4
C3
4341418
GND
VIHFAMP
3203771
220R/100MHz
L2150
L2151
220R/100MHz
L2154
L2155
220R/100MHz
220R/100MHz
C2154
27p0
C2155
4u7
GND
GND
Place near PVDD pin
Place near power pins
not_assembled
C2161
100p
not_assembled
C2162
100p
C2156
100p
C2157
100p
C2158
100p
C2159
100p
GND
GND
GND
GND
IHFR_P
IHFR_N
IHFL_P
IHFL_N
8
7
INT_AUDIO(10:0)
IHFL located at sub PWB
3645361
L2152
56nH
L2153
56nH
E2151
E2150
1
1
R2150
18V/30V
R2151
18V/30V
GND
GND
VBAT
VIHFAMP
L2158
220R/100MHz
3203771
C2160
100n
2351017
GND
Place near AVDD pin

Figure 81 Internal speakers

Vibra circuitry

Vibra is used for the vibra alarm function.

The vibra motor is connected to the Avilma ASIC VibraP and VibraN Pulse Width Modulated (PWM) outputs.

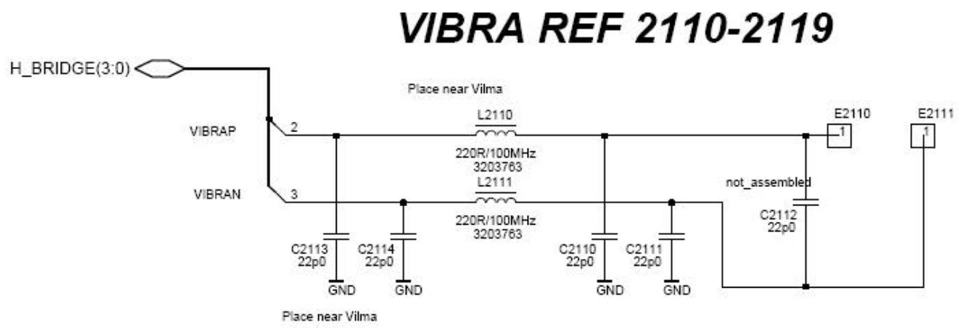
VIBRA REF 2110-2119
H_BRIDGE(3:0)
VIBRAP
VIBRAN
2
3
Place near Vilma
L2110
220R/100MHz
3203763
L2111
220R/100MHz
3203763
C2113
22p0
C2114
22p0
GND
GND
Place near Vilma
C2110
22p0
C2111
22p0
GND
GND
not_assembled
C2112
22p0
E2110
E2111
1
1

Figure 82 Vibra circuitry

Accessory AV connector

The features that are supported by Gadget accessory interface are the following:

- Audio output (stereo headset/headphones having the impedance >16ohm)
- Audio input (mono microphone from headset)
- Control data (ECI)
- TV-out with composite signal to 75ohm coax cable
- Connects FM receiver to headphones, which serves as FM antenna

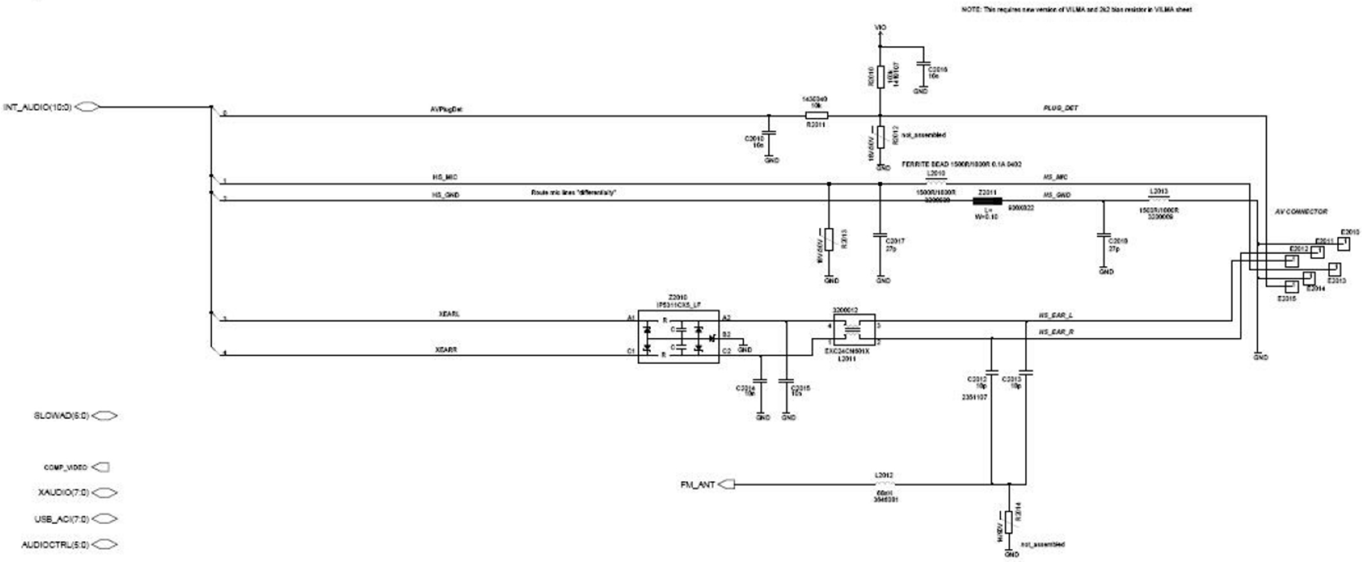
NOTE: This requires new version of VILMA and 2k2 bias resistor in VILMA sheet
INT_AUDIO(10:0)
AVPlugDet
HS_MIC
HS_GND
Route mic lines "differentially"
XEARL
XEARR
Z2010
IP5311CX5_LF
A1
A2
B2
C1
C2
R
C
GND
VIO
R2010
100k
C2016
10n
C2010
10n
R2011
10k
PLUG_DET
R2012
not_assembled
FERRITE BEAD 1500R/1000R 0.1A 0402
L2010
1500R/1000R
Z2011
W=0.10
HS_MIC
HS_GND
L2013
1500R/1000R
R2013
C2017
27p
C2018
27p
AV CONNECTOR
E2010
E2011
E2012
E2013
E2014
E2015
3200012
EXC24CN601X
L2011
HS_EAR_L
HS_EAR_R
C2014
C2015
C2012
10p
2351107
C2013
10p
FM_ANT
L2012
R2014
not_assembled
SLOWAD(6:0)
COMP_VIDEO
XAUDIO(7:0)
USB_ACI(7:0)
AUDIOCTRL(5:0)

Figure 83 Accessory (AV) connector

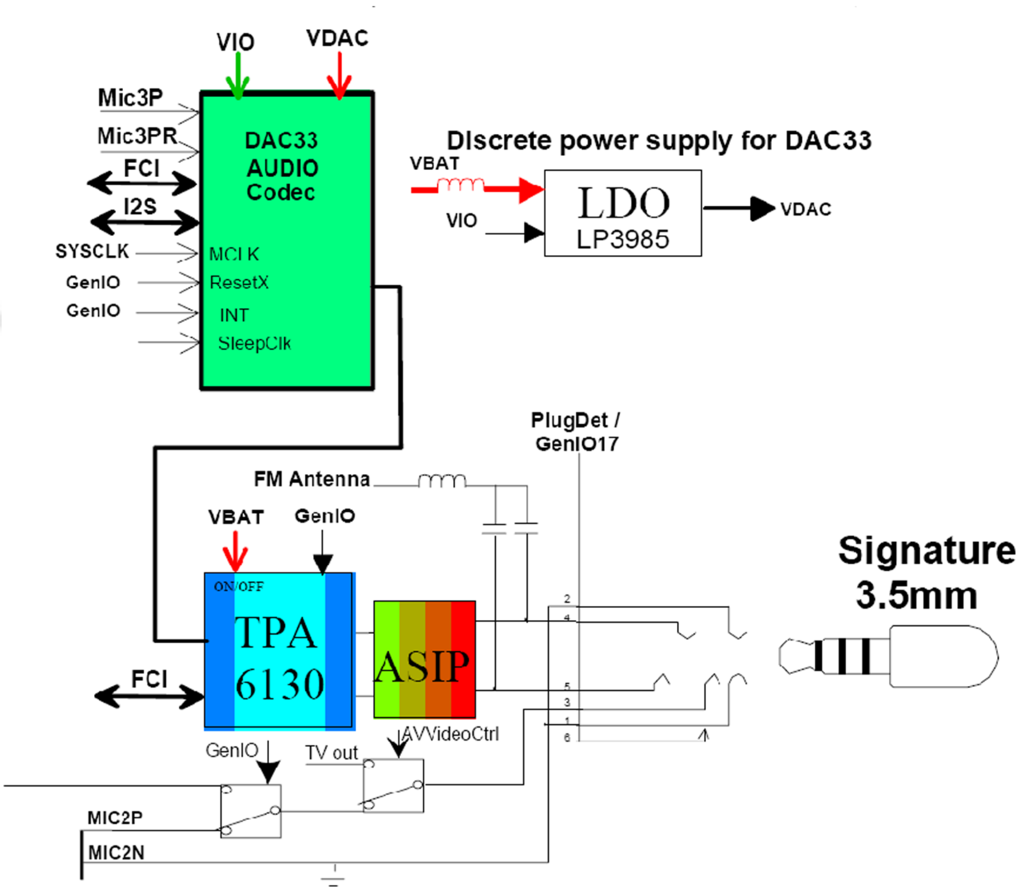
VIO
VDAC
Mic3P
Mic3PR
FCI
I2S
SYSCLK
GenIO
GenIO
DAC33
AUDIO
Codec
MCLK
ResetX
INT
SleepClk
Discrete power supply for DAC33
VBAT
VIO
LDO
LP3985
VDAC
PlugDet /
GenIO17
FM Antenna
VBAT
GenIO
ON/OFF
TPA
6130
ASIP
Signature
3.5mm
FCI
GenIO
TV out
AVVideoCtrl
MIC2P
MIC2N
2
4
5
3
1
6

Figure 84 Accessory (AV) connector with DAC33 and TPA6130 audio enhancements

External earpiece and microphone

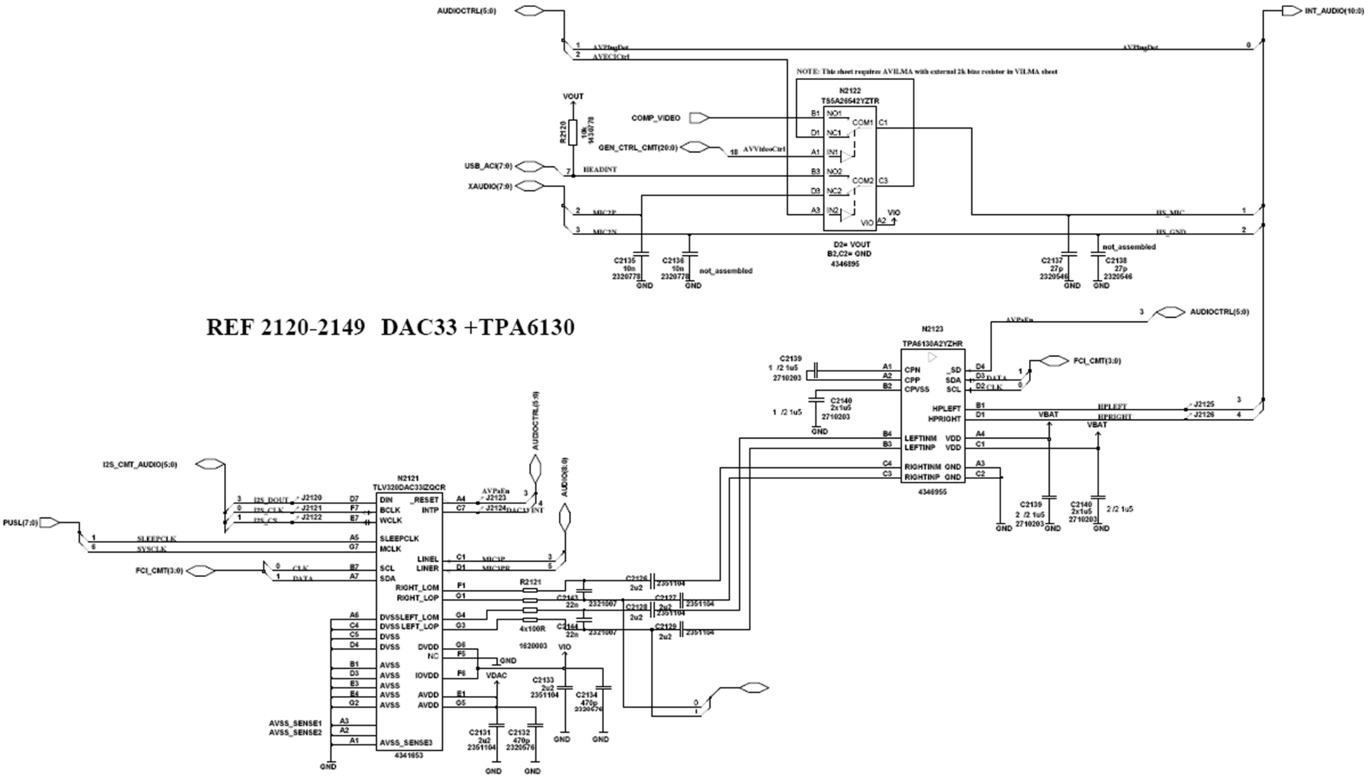
AUDIOCTRL(5:0)
INT_AUDIO(10:0)
NOTE: This sheet requires AVILMA with external 2k bias resistor in VILMA sheet
N2122
TS5A20542YZTR
VOUT
COMP_VIDEO
GEN_CTRL_CMT(20:0)
USB_ACI(7:0)
XAUDIO(7:0)
R2120
C2135
C2136
not_assembled
C2137
C2138
REF 2120-2149 DAC33 +TPA6130
N2123
TPA6130A2YZHR
FCI_CMT(3:0)
I2S_CMT_AUDIO(5:0)
PUSL(7:0)
FCI_CMT(3:0)
N2121
TLV320DAC33IZQCR
AVSS_SENSE1
AVSS_SENSE2
GND
VIO
VBAT
VDAC

Figure 85 External earpiece and microphone audio circuit

Baseband technical specifications

External interfaces

Name of connection	Connector reference
HS USB	X3300
MicroSD card	X3200
Battery connector	X2070
SIM card reader	X2700
Accessory (AV) connector	X2010
Charger	X3300

SIM IF connections

Pin	Signal	I/O	Engine connection		Notes
1	VSIM	Out	EM ASIC N2200	VSIM1	Supply voltage to SIM card, 1.8V or 3.0V.
2	SIMRST	Out	EM ASIC N2200	SIM1Rst	Reset signal to SIM card
3	SIMCLK	Out	EM ASIC N2200	SIM1ClkC	Clock signal to SIM card
5	GND	-	GND		Ground
7	SIMDATA	In/Out	EM ASIC N2200	SIM1DaC	Data input / output

Charger connector and charging interface connections & electrical characteristics

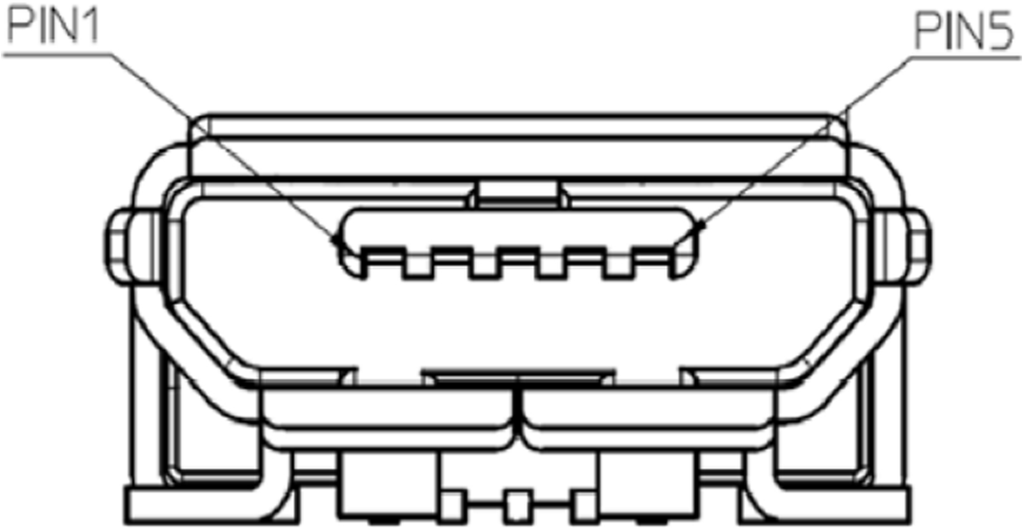

Figure 86 Charger connector

Table 11 Charging interface connections

PIN	Signal	I/O	Engine connection		Description
1	VBUS	IN	D3300/ N3301	VBUS/DCIN	5V
2	D-	IN/OUT	D3300	DM	Data minus
3	D+	IN/OUT	D3300	DN	Data plus
4	ID				Not in use
5	ground		Ground		Signal ground

Table 12 Charging IF electrical characteristics

Description	Parameter	Min	Max	Unit
VBUS	Vcharge	4.75	5.25	V
VBUS	Icharge		1.8	A
D+,D-,Ground			1	A

Internal interfaces

Name of connection	Component reference
DALS	N6502
Earpiece	B2100
Microphone	B2 (On UI Module)
IHF speakers	B2151 / B1
Main camera socket	X1450
Sub-camera	N1450
Main display connector	X2450
Vibra	M2110

Back-up battery interface electrical characteristics

Table 13 Back-up battery electrical characteristics

Description	Parameter	Min	Typ	Max	Unit
Back-Up Battery Voltage	Vback	0	2.5	2.7	V

RF technical description

RF block diagram

RM-333

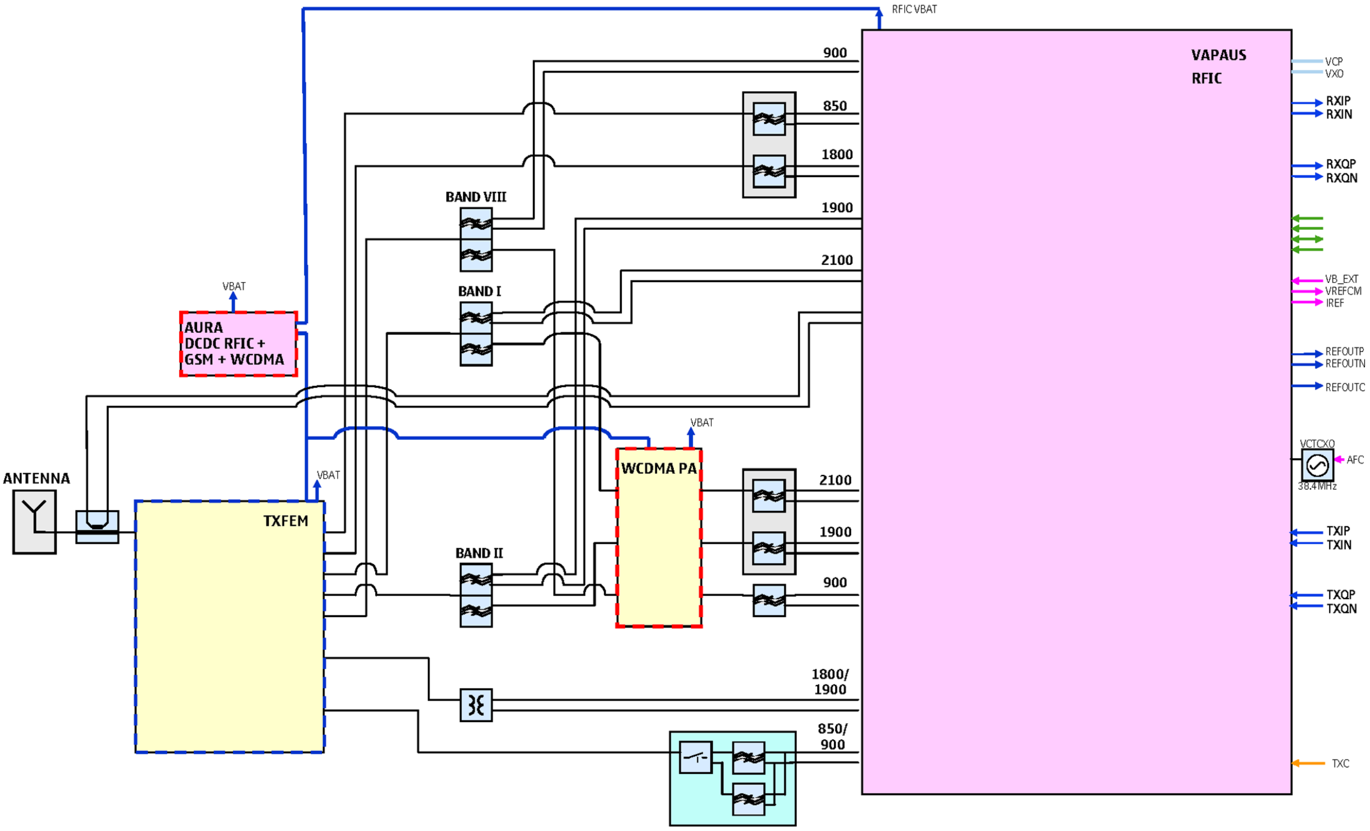
RFIC VBAT
VAPAUS
RFIC
900
850
1800
1900
2100
BAND VIII
BAND I
VBAT
AURA
DCDC RFIC +
GSM + WCDMA
VBAT
WCDMA PA
ANTENNA
VBAT
TXFEM
BAND II
2100
1900
900
1800/
1900
850/
900
VCP
VXO
RXIP
RXIN
RXQP
RXQN
VB_EXT
VREFCM
IREF
REFOUTP
REFOUTN
REFOUTC
VCTCXO
AFC
38.4MHz
TXIP
TXIN
TXQP
TXQN
TXC

Figure 87 RF block diagram RM-333 using RF ASIC N7500

RM-334

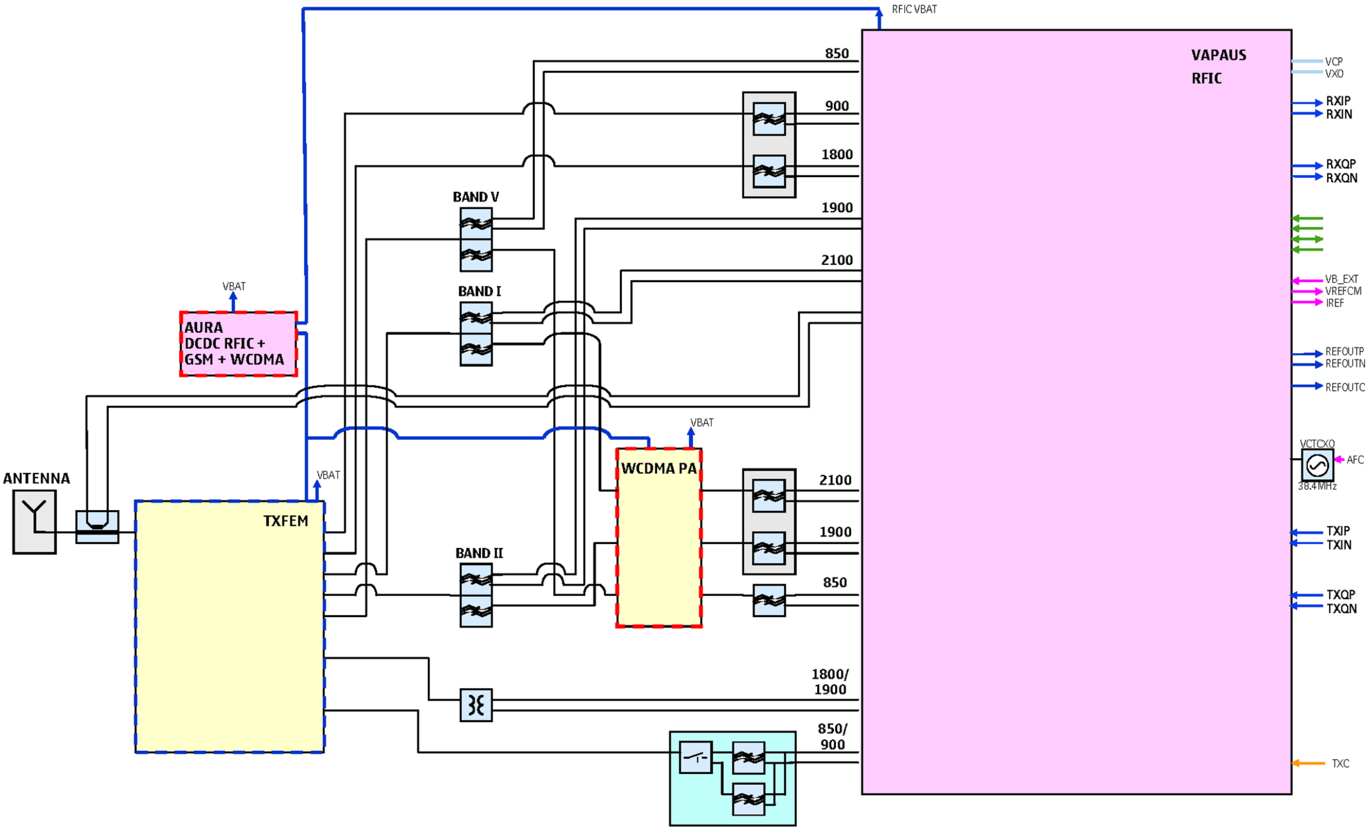
RFIC VBAT
VAPAUS
RFIC
850
900
1800
1900
2100
VCP
VXO
RXIP
RXIN
RXQP
RXQN
VB_EXT
VREFCM
IREF
REFOUTP
REFOUTN
REFOUTC
VCTCXO
AFC
38.4MHz
TXIP
TXIN
TXQP
TXQN
TXC
BAND V
BAND I
BAND II
VBAT
AURA
DCDC RFIC +
GSM + WCDMA
ANTENNA
TXFEM
WCDMA PA
2100
1900
850
1800/
1900
850/
900

Figure 88 RF block diagram RM-334 using RF ASIC N7500

The RF block diagram uses RF ASIC N7500 that performs the RF back-end functions of receive and transmit function of the cellular transceiver.

Receiver (RX)

An analogue signal is received by the phone's antenna. The signal is converted to a digital signal and is then transferred further to the baseband (eg. to the earpiece).

The receiver functions are implemented in the RF ASIC.

Signals with different frequencies take different paths, therefore being handled by different components. The principle of GSM and WCDMA is the same.

Transmitter (TX)

The digital baseband signal (eg. from the microphone) is converted to an analogue signal, which is then amplified and transmitted from the antenna. The frequency of this signal can be tuned to match the bandwith of the system in use (eg. GSM900).

The transmitter functions are implemented in the RF ASIC.

Even though the GSM and WCDMA signals are sent via different components, the principles of the transmission is the same.

Frequency mappings

GSM850 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
128	824.2	869.2	3296.8	3476.8	170	832.6	877.6	3330.4	3510.4	212	841.0	886.0	3364.0	3544.0
129	824.4	869.4	3297.6	3477.6	171	832.8	877.8	3331.2	3511.2	213	841.2	886.2	3364.8	3544.8
130	824.6	869.6	3298.4	3478.4	172	833.0	878.0	3332.0	3512.0	214	841.4	886.4	3365.6	3545.6
131	824.8	869.8	3299.2	3479.2	173	833.2	878.2	3332.8	3512.8	215	841.6	886.6	3366.4	3546.4
132	825.0	870.0	3300.0	3480.0	174	833.4	878.4	3333.6	3513.6	216	841.8	886.8	3367.2	3547.2
133	825.2	870.2	3300.8	3480.8	175	833.6	878.6	3334.4	3514.4	217	842.0	887.0	3368.0	3548.0
134	825.4	870.4	3301.6	3481.6	176	833.8	878.8	3335.2	3515.2	218	842.2	887.2	3368.8	3548.8
135	825.6	870.6	3302.4	3482.4	177	834.0	879.0	3336.0	3516.0	219	842.4	887.4	3369.6	3549.6
136	825.8	870.8	3303.2	3483.2	178	834.2	879.2	3336.8	3516.8	220	842.6	887.6	3370.4	3550.4
137	826.0	871.0	3304.0	3484.0	179	834.4	879.4	3337.6	3517.6	221	842.8	887.8	3371.2	3551.2
138	826.2	871.2	3304.8	3484.8	180	834.6	879.6	3338.4	3518.4	222	843.0	888.0	3372.0	3552.0
139	826.4	871.4	3305.6	3485.6	181	834.8	879.8	3339.2	3519.2	223	843.2	888.2	3372.8	3552.8
140	826.6	871.6	3306.4	3486.4	182	835.0	880.0	3340.0	3520.0	224	843.4	888.4	3373.6	3553.6
141	826.8	871.8	3307.2	3487.2	183	835.2	880.2	3340.8	3520.8	225	843.6	888.6	3374.4	3554.4
142	827.0	872.0	3308.0	3488.0	184	835.4	880.4	3341.6	3521.6	226	843.8	888.8	3375.2	3555.2
143	827.2	872.2	3308.8	3488.8	185	835.6	880.6	3342.4	3522.4	227	844.0	889.0	3376.0	3556.0
144	827.4	872.4	3309.6	3489.6	186	835.8	880.8	3343.2	3523.2	228	844.2	889.2	3376.8	3556.8
145	827.6	872.6	3310.4	3490.4	187	836.0	881.0	3344.0	3524.0	229	844.4	889.4	3377.6	3557.6
146	827.8	872.8	3311.2	3491.2	188	836.2	881.2	3344.8	3524.8	230	844.6	889.6	3378.4	3558.4
147	828.0	873.0	3312.0	3492.0	189	836.4	881.4	3345.6	3525.6	231	844.8	889.8	3379.2	3559.2
148	828.2	873.2	3312.8	3492.8	190	836.6	881.6	3346.4	3526.4	232	845.0	890.0	3380.0	3560.0
149	828.4	873.4	3313.6	3493.6	191	836.8	881.8	3347.2	3527.2	233	845.2	890.2	3380.8	3560.8
150	828.6	873.6	3314.4	3494.4	192	837.0	882.0	3348.0	3528.0	234	845.4	890.4	3381.6	3561.6
151	828.8	873.8	3315.2	3495.2	193	837.2	882.2	3348.8	3528.8	235	845.6	890.6	3382.4	3562.4
152	829.0	874.0	3316.0	3496.0	194	837.4	882.4	3349.6	3529.6	236	845.8	890.8	3383.2	3563.2
153	829.2	874.2	3316.8	3496.8	195	837.6	882.6	3350.4	3530.4	237	846.0	891.0	3384.0	3564.0
154	829.4	874.4	3317.6	3497.6	196	837.8	882.8	3351.2	3531.2	238	846.2	891.2	3384.8	3564.8
155	829.6	874.6	3318.4	3498.4	197	838.0	883.0	3352.0	3532.0	239	846.4	891.4	3385.6	3565.6
156	829.8	874.8	3319.2	3499.2	198	838.2	883.2	3352.8	3532.8	240	846.6	891.6	3386.4	3566.4
157	830.0	875.0	3320.0	3500.0	199	838.4	883.4	3353.6	3533.6	241	846.8	891.8	3387.2	3567.2
158	830.2	875.2	3320.8	3500.8	200	838.6	883.6	3354.4	3534.4	242	847.0	892.0	3388.0	3568.0
159	830.4	875.4	3321.6	3501.6	201	838.8	883.8	3355.2	3535.2	243	847.2	892.2	3388.8	3568.8
160	830.6	875.6	3322.4	3502.4	202	839.0	884.0	3356.0	3536.0	244	847.4	892.4	3389.6	3569.6
161	830.8	875.8	3323.2	3503.2	203	839.2	884.2	3356.8	3536.8	245	847.6	892.6	3390.4	3570.4
162	831.0	876.0	3324.0	3504.0	204	839.4	884.4	3357.6	3537.6	246	847.8	892.8	3391.2	3571.2
163	831.2	876.2	3324.8	3504.8	205	839.6	884.6	3358.4	3538.4	247	848.0	893.0	3392.0	3572.0
164	831.4	876.4	3325.6	3505.6	206	839.8	884.8	3359.2	3539.2	248	848.2	893.2	3392.8	3572.8
165	831.6	876.6	3326.4	3506.4	207	840.0	885.0	3360.0	3540.0	249	848.4	893.4	3393.6	3573.6
166	831.8	876.8	3327.2	3507.2	208	840.2	885.2	3360.8	3540.8	250	848.6	893.6	3394.4	3574.4
167	832.0	877.0	3328.0	3508.0	209	840.4	885.4	3361.6	3541.6	251	848.8	893.8	3395.2	3575.2

EGSM900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
975	880,2	925,2	3520,8	3700,8	1	890,2	935,2	3560,8	3740,8	63	902,6	947,6	3610,4	3790,4
976	880,4	925,4	3521,6	3701,6	2	890,4	935,4	3561,6	3741,6	64	902,8	947,8	3611,2	3791,2
977	880,6	925,6	3522,4	3702,4	3	890,6	935,6	3562,4	3742,4	65	903,0	948,0	3612,0	3792,0
978	880,8	925,8	3523,2	3703,2	4	890,8	935,8	3563,2	3743,2	66	903,2	948,2	3612,8	3792,8
979	881,0	926,0	3524,0	3704,0	5	891,0	936,0	3564,0	3744,0	67	903,4	948,4	3613,6	3793,6
980	881,2	926,2	3524,8	3704,8	6	891,2	936,2	3564,8	3744,8	68	903,6	948,6	3614,4	3794,4
981	881,4	926,4	3525,6	3705,6	7	891,4	936,4	3565,6	3745,6	69	903,8	948,8	3615,2	3795,2
982	881,6	926,6	3526,4	3706,4	8	891,6	936,6	3566,4	3746,4	70	904,0	949,0	3616,0	3796,0
983	881,8	926,8	3527,2	3707,2	9	891,8	936,8	3567,2	3747,2	71	904,2	949,2	3616,8	3796,8
984	882,0	927,0	3528,0	3708,0	10	892,0	937,0	3568,0	3748,0	72	904,4	949,4	3617,6	3797,6
985	882,2	927,2	3528,8	3708,8	11	892,2	937,2	3568,8	3748,8	73	904,6	949,6	3618,4	3798,4
986	882,4	927,4	3529,6	3709,6	12	892,4	937,4	3569,6	3749,6	74	904,8	949,8	3619,2	3799,2
987	882,6	927,6	3530,4	3710,4	13	892,6	937,6	3570,4	3750,4	75	905,0	950,0	3620,0	3800,0
988	882,8	927,8	3531,2	3711,2	14	892,8	937,8	3571,2	3751,2	76	905,2	950,2	3620,8	3800,8
989	883,0	928,0	3532,0	3712,0	15	893,0	938,0	3572,0	3752,0	77	905,4	950,4	3621,6	3801,6
990	883,2	928,2	3532,8	3712,8	16	893,2	938,2	3572,8	3752,8	78	905,6	950,6	3622,4	3802,4
991	883,4	928,4	3533,6	3713,6	17	893,4	938,4	3573,6	3753,6	79	905,8	950,8	3623,2	3803,2
992	883,6	928,6	3534,4	3714,4	18	893,6	938,6	3574,4	3754,4	80	906,0	951,0	3624,0	3804,0
993	883,8	928,8	3535,2	3715,2	19	893,8	938,8	3575,2	3755,2	81	906,2	951,2	3624,8	3804,8
994	884,0	929,0	3536,0	3716,0	20	894,0	939,0	3576,0	3756,0	82	906,4	951,4	3625,6	3805,6
995	884,2	929,2	3536,8	3716,8	21	894,2	939,2	3576,8	3756,8	83	906,6	951,6	3626,4	3806,4
996	884,4	929,4	3537,6	3717,6	22	894,4	939,4	3577,6	3757,6	84	906,8	951,8	3627,2	3807,2
997	884,6	929,6	3538,4	3718,4	23	894,6	939,6	3578,4	3758,4	85	907,0	952,0	3628,0	3808,0
998	884,8	929,8	3539,2	3719,2	24	894,8	939,8	3579,2	3759,2	86	907,2	952,2	3628,8	3808,8
999	885,0	930,0	3540,0	3720,0	25	895,0	940,0	3580,0	3760,0	87	907,4	952,4	3629,6	3809,6
1000	885,2	930,2	3540,8	3720,8	26	895,2	940,2	3580,8	3760,8	88	907,6	952,6	3630,4	3810,4
1001	885,4	930,4	3541,6	3721,6	27	895,4	940,4	3581,6	3761,6	89	907,8	952,8	3631,2	3811,2
1002	885,6	930,6	3542,4	3722,4	28	895,6	940,6	3582,4	3762,4	90	908,0	953,0	3632,0	3812,0
1003	885,8	930,8	3543,2	3723,2	29	895,8	940,8	3583,2	3763,2	91	908,2	953,2	3632,8	3812,8
1004	886,0	931,0	3544,0	3724,0	30	896,0	941,0	3584,0	3764,0	92	908,4	953,4	3633,6	3813,6
1005	886,2	931,2	3544,8	3724,8	31	896,2	941,2	3584,8	3764,8	93	908,6	953,6	3634,4	3814,4
1006	886,4	931,4	3545,6	3725,6	32	896,4	941,4	3585,6	3765,6	94	908,8	953,8	3635,2	3815,2
1007	886,6	931,6	3546,4	3726,4	33	896,6	941,6	3586,4	3766,4	95	909,0	954,0	3636,0	3816,0
1008	886,8	931,8	3547,2	3727,2	34	896,8	941,8	3587,2	3767,2	96	909,2	954,2	3636,8	3816,8
1009	887,0	932,0	3548,0	3728,0	35	897,0	942,0	3588,0	3768,0	97	909,4	954,4	3637,6	3817,6
1010	887,2	932,2	3548,8	3728,8	36	897,2	942,2	3588,8	3768,8	98	909,6	954,6	3638,4	3818,4
1011	887,4	932,4	3549,6	3729,6	37	897,4	942,4	3589,6	3769,6	99	909,8	954,8	3639,2	3819,2
1012	887,6	932,6	3550,4	3730,4	38	897,6	942,6	3590,4	3770,4	100	910,0	955,0	3640,0	3820,0
1013	887,8	932,8	3551,2	3731,2	39	897,8	942,8	3591,2	3771,2	101	910,2	955,2	3640,8	3820,8
1014	888,0	933,0	3552,0	3732,0	40	898,0	943,0	3592,0	3772,0	102	910,4	955,4	3641,6	3821,6
1015	888,2	933,2	3552,8	3732,8	41	898,2	943,2	3592,8	3772,8	103	910,6	955,6	3642,4	3822,4
1016	888,4	933,4	3553,6	3733,6	42	898,4	943,4	3593,6	3773,6	104	910,8	955,8	3643,2	3823,2
1017	888,6	933,6	3554,4	3734,4	43	898,6	943,6	3594,4	3774,4	105	911,0	956,0	3644,0	3824,0
1018	888,8	933,8	3555,2	3735,2	44	898,8	943,8	3595,2	3775,2	106	911,2	956,2	3644,8	3824,8
1019	889,0	934,0	3556,0	3736,0	45	899,0	944,0	3596,0	3776,0	107	911,4	956,4	3645,6	3825,6
1020	889,2	934,2	3556,8	3736,8	46	899,2	944,2	3596,8	3776,8	108	911,6	956,6	3646,4	3826,4
1021	889,4	934,4	3557,6	3737,6	47	899,4	944,4	3597,6	3777,6	109	911,8	956,8	3647,2	3827,2
1022	889,6	934,6	3558,4	3738,4	48	899,6	944,6	3598,4	3778,4	110	912,0	957,0	3648,0	3828,0
1023	889,8	934,8	3559,2	3739,2	49	899,8	944,8	3599,2	3779,2	111	912,2	957,2	3648,8	3828,8
0	890,0	935,0	3560,0	3740,0	50	900,0	945,0	3600,0	3780,0	112	912,4	957,4	3649,6	3829,6
					51	900,2	945,2	3600,8	3780,8	113	912,6	957,6	3650,4	3830,4
					52	900,4	945,4	3601,6	3781,6	114	912,8	957,8	3651,2	3831,2
					53	900,6	945,6	3602,4	3782,4	115	913,0	958,0	3652,0	3832,0
					54	900,8	945,8	3603,2	3783,2	116	913,2	958,2	3652,8	3832,8
					55	901,0	946,0	3604,0	3784,0	117	913,4	958,4	3653,6	3833,6
					56	901,2	946,2	3604,8	3784,8	118	913,6	958,6	3654,4	3834,4
					57	901,4	946,4	3605,6	3785,6	119	913,8	958,8	3655,2	3835,2
					58	901,6	946,6	3606,4	3786,4	120	914,0	959,0	3656,0	3836,0
					59	901,8	946,8	3607,2	3787,2	121	914,2	959,2	3656,8	3836,8
					60	902,0	947,0	3608,0	3788,0	122	914,4	959,4	3657,6	3837,6
					61	902,2	947,2	3608,8	3788,8	123	914,6	959,6	3658,4	3838,4
					62	902,4	947,4	3609,6	3789,6	124	914,8	959,8	3659,2	3839,2

GSM1800 frequencies

Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx	Ch	Tx	Rx	VCO Tx	VCO Rx
512	1710.2	1805.2	3420.4	3610.4	606	1729.0	1824.0	3458.0	3648.0	700	1747.8	1842.8	3495.6	3685.6	793	1766.4	1861.4	3532.8	3722.8
513	1710.4	1805.4	3420.8	3610.8	607	1729.2	1824.2	3458.4	3648.4	701	1748.0	1843.0	3496.0	3686.0	794	1766.6	1861.6	3533.2	3723.2
514	1710.6	1805.6	3421.2	3611.2	608	1729.4	1824.4	3458.8	3648.8	702	1748.2	1843.2	3496.4	3686.4	795	1766.8	1861.8	3533.6	3723.6
515	1710.8	1805.8	3421.6	3611.6	609	1729.6	1824.6	3459.2	3649.2	703	1748.4	1843.4	3496.8	3686.8	796	1767.0	1862.0	3534.0	3724.0
516	1711.0	1806.0	3422.0	3612.0	610	1729.8	1824.8	3459.6	3649.6	704	1748.6	1843.6	3497.2	3687.2	797	1767.2	1862.2	3534.4	3724.4
517	1711.2	1806.2	3422.4	3612.4	611	1730.0	1825.0	3460.0	3650.0	705	1748.8	1843.8	3497.6	3687.6	798	1767.4	1862.4	3534.8	3724.8
518	1711.4	1806.4	3422.8	3612.8	612	1730.2	1825.2	3460.4	3650.4	706	1749.0	1844.0	3498.0	3688.0	799	1767.6	1862.6	3535.2	3725.2
519	1711.6	1806.6	3423.2	3613.2	613	1730.4	1825.4	3460.8	3650.8	707	1749.2	1844.2	3498.4	3688.4	800	1767.8	1862.8	3535.6	3725.6
520	1711.8	1806.8	3423.6	3613.6	614	1730.6	1825.6	3461.2	3651.2	708	1749.4	1844.4	3498.8	3688.8	801	1768.0	1863.0	3536.0	3726.0
521	1712.0	1807.0	3424.0	3614.0	615	1730.8	1825.8	3461.6	3651.6	709	1749.6	1844.6	3499.2	3689.2	802	1768.2	1863.2	3536.4	3726.4
522	1712.2	1807.2	3424.4	3614.4	616	1731.0	1826.0	3462.0	3652.0	710	1749.8	1844.8	3499.6	3689.6	803	1768.4	1863.4	3536.8	3726.8
523	1712.4	1807.4	3424.8	3614.8	617	1731.2	1826.2	3462.4	3652.4	711	1750.0	1845.0	3500.0	3690.0	804	1768.6	1863.6	3537.2	3727.2
524	1712.6	1807.6	3425.2	3615.2	618	1731.4	1826.4	3462.8	3652.8	712	1750.2	1845.2	3500.4	3690.4	805	1768.8	1863.8	3537.6	3727.6
525	1712.8	1807.8	3425.6	3615.6	619	1731.6	1826.6	3463.2	3653.2	713	1750.4	1845.4	3500.8	3690.8	806	1769.0	1864.0	3538.0	3728.0
526	1713.0	1808.0	3426.0	3616.0	620	1731.8	1826.8	3463.6	3653.6	714	1750.6	1845.6	3501.2	3691.2	807	1769.2	1864.2	3538.4	3728.4
527	1713.2	1808.2	3426.4	3616.4	621	1732.0	1827.0	3464.0	3654.0	715	1750.8	1845.8	3501.6	3691.6	808	1769.4	1864.4	3538.8	3728.8
528	1713.4	1808.4	3426.8	3616.8	622	1732.2	1827.2	3464.4	3654.4	716	1751.0	1846.0	3502.0	3692.0	809	1769.6	1864.6	3539.2	3729.2
529	1713.6	1808.6	3427.2	3617.2	623	1732.4	1827.4	3464.8	3654.8	717	1751.2	1846.2	3502.4	3692.4	810	1769.8	1864.8	3539.6	3729.6
530	1713.8	1808.8	3427.6	3617.6	624	1732.6	1827.6	3465.2	3655.2	718	1751.4	1846.4	3502.8	3692.8	811	1770.0	1865.0	3540.0	3730.0
531	1714.0	1809.0	3428.0	3618.0	625	1732.8	1827.8	3465.6	3655.6	719	1751.6	1846.6	3503.2	3693.2	812	1770.2	1865.2	3540.4	3730.4
532	1714.2	1809.2	3428.4	3618.4	626	1733.0	1828.0	3466.0	3656.0	720	1751.8	1846.8	3503.6	3693.6	813	1770.4	1865.4	3540.8	3730.8
533	1714.4	1809.4	3428.8	3618.8	627	1733.2	1828.2	3466.4	3656.4	721	1752.0	1847.0	3504.0	3694.0	814	1770.6	1865.6	3541.2	3731.2
534	1714.6	1809.6	3429.2	3619.2	628	1733.4	1828.4	3466.8	3656.8	722	1752.2	1847.2	3504.4	3694.4	815	1770.8	1865.8	3541.6	3731.6
535	1714.8	1809.8	3429.6	3619.6	629	1733.6	1828.6	3467.2	3657.2	723	1752.4	1847.4	3504.8	3694.8	816	1771.0	1866.0	3542.0	3732.0
536	1715.0	1810.0	3430.0	3620.0	630	1733.8	1828.8	3467.6	3657.6	724	1752.6	1847.6	3505.2	3695.2	817	1771.2	1866.2	3542.4	3732.4
537	1715.2	1810.2	3430.4	3620.4	631	1734.0	1829.0	3468.0	3658.0	725	1752.8	1847.8	3505.6	3695.6	818	1771.4	1866.4	3542.8	3732.8
538	1715.4	1810.4	3430.8	3620.8	632	1734.2	1829.2	3468.4	3658.4	726	1753.0	1848.0	3506.0	3696.0	819	1771.6	1866.6	3543.2	3733.2
539	1715.6	1810.6	3431.2	3621.2	633	1734.4	1829.4	3468.8	3658.8	727	1753.2	1848.2	3506.4	3696.4	820	1771.8	1866.8	3543.6	3733.6
540	1715.8	1810.8	3431.6	3621.6	634	1734.6	1829.6	3469.2	3659.2	728	1753.4	1848.4	3506.8	3696.8	821	1772.0	1867.0	3544.0	3734.0
541	1716.0	1811.0	3432.0	3622.0	635	1734.8	1829.8	3469.6	3659.6	729	1753.6	1848.6	3507.2	3697.2	822	1772.2	1867.2	3544.4	3734.4
542	1716.2	1811.2	3432.4	3622.4	636	1735.0	1830.0	3470.0	3660.0	730	1753.8	1848.8	3507.6	3697.6	823	1772.4	1867.4	3544.8	3734.8
543	1716.4	1811.4	3432.8	3622.8	637	1735.2	1830.2	3470.4	3660.4	731	1754.0	1849.0	3508.0	3698.0	824	1772.6	1867.6	3545.2	3735.2
544	1716.6	1811.6	3433.2	3623.2	638	1735.4	1830.4	3470.8	3660.8	732	1754.2	1849.2	3508.4	3698.4	825	1772.8	1867.8	3545.6	3735.6
545	1716.8	1811.8	3433.6	3623.6	639	1735.6	1830.6	3471.2	3661.2	733	1754.4	1849.4	3508.8	3698.8	826	1773.0	1868.0	3546.0	3736.0
546	1717.0	1812.0	3434.0	3624.0	640	1735.8	1830.8	3471.6	3661.6	734	1754.6	1849.6	3509.2	3699.2	827	1773.2	1868.2	3546.4	3736.4
547	1717.2	1812.2	3434.4	3624.4	641	1736.0	1831.0	3472.0	3662.0	735	1754.8	1849.8	3509.6	3699.6	828	1773.4	1868.4	3546.8	3736.8
548	1717.4	1812.4	3434.8	3624.8	642	1736.2	1831.2	3472.4	3662.4	736	1755.0	1850.0	3510.0	3700.0	829	1773.6	1868.6	3547.2	3737.2
549	1717.6	1812.6	3435.2	3625.2	643	1736.4	1831.4	3472.8	3662.8	737	1755.2	1850.2	3510.4	3700.4	830	1773.8	1868.8	3547.6	3737.6
550	1717.8	1812.8	3435.6	3625.6	644	1736.6	1831.6	3473.2	3663.2	738	1755.4	1850.4	3510.8	3700.8	831	1774.0	1869.0	3548.0	3738.0
551	1718.0	1813.0	3436.0	3626.0	645	1736.8	1831.8	3473.6	3663.6	739	1755.6	1850.6	3511.2	3701.2	832	1774.2	1869.2	3548.4	3738.4
552	1718.2	1813.2	3436.4	3626.4	646	1737.0	1832.0	3474.0	3664.0	740	1755.8	1850.8	3511.6	3701.6	833	1774.4	1869.4	3548.8	3738.8
553	1718.4	1813.4	3436.8	3626.8	647	1737.2	1832.2	3474.4	3664.4	741	1756.0	1851.0	3512.0	3702.0	834	1774.6	1869.6	3549.2	3739.2
554	1718.6	1813.6	3437.2	3627.2	648	1737.4	1832.4	3474.8	3664.8	742	1756.2	1851.2	3512.4	3702.4	835	1774.8	1869.8	3549.6	3739.6
555	1718.8	1813.8	3437.6	3627.6	649	1737.6	1832.6	3475.2	3665.2	743	1756.4	1851.4	3512.8	3702.8	836	1775.0	1870.0	3550.0	3740.0
556	1719.0	1814.0	3438.0	3628.0	650	1737.8	1832.8	3475.6	3665.6	744	1756.6	1851.6	3513.2	3703.2	837	1775.2	1870.2	3550.4	3740.4
557	1719.2	1814.2	3438.4	3628.4	651	1738.0	1833.0	3476.0	3666.0	745	1756.8	1851.8	3513.6	3703.6	838	1775.4	1870.4	3550.8	3740.8
558	1719.4	1814.4	3438.8	3628.8	652	1738.2	1833.2	3476.4	3666.4	746	1757.0	1852.0	3514.0	3704.0	839	1775.6	1870.6	3551.2	3741.2
559	1719.6	1814.6	3439.2	3629.2	653	1738.4	1833.4	3476.8	3666.8	747	1757.2	1852.2	3514.4	3704.4	840	1775.8	1870.8	3551.6	3741.6
560	1719.8	1814.8	3439.6	3629.6	654	1738.6	1833.6	3477.2	3667.2	748	1757.4	1852.4	3514.8	3704.8	841	1776.0	1871.0	3552.0	3742.0
561	1720.0	1815.0	3440.0	3630.0	655	1738.8	1833.8	3477.6	3667.6	749	1757.6	1852.6	3515.2	3705.2	842	1776.2	1871.2	3552.4	3742.4
562	1720.2	1815.2	3440.4	3630.4	656	1739.0	1834.0	3478.0	3668.0	750	1757.8	1852.8	3515.6	3705.6	843	1776.4	1871.4	3552.8	3742.8
563	1720.4	1815.4	3440.8	3630.8	657	1739.2	1834.2	3478.4	3668.4	751	1758.0	1853.0	3516.0	3706.0	844	1776.6	1871.6	3553.2	3743.2
564	1720.6	1815.6	3441.2	3631.2	658	1739.4	1834.4	3478.8	3668.8	752	1758.2	1853.2	3516.4	3706.4	845	1776.8	1871.8	3553.6	3743.6
565	1720.8	1815.8	3441.6	3631.6	659	1739.6	1834.6	3479.2	3669.2	753	1758.4	1853.4	3516.8	3706.8	846	1777.0	1872.0	3554.0	3744.0
566	1721.0	1816.0	3442.0	3632.0	660	1739.8	1834.8	3479.6	3669.6	754	1758.6	1853.6	3517.2	3707.2	847	1777.2	1872.2	3554.4	3744.4
567	1721.2	1816.2	3442.4	3632.4	661	1740.0	1835.0	3480.0	3670.0	755	1758.8	1853.8	3517.6	3707.6	848	1777.4	1872.4	3554.8	3744.8
568	1721.4	1816.4	3442.8	3632.8	662	1740.2	1835.2	3480.4	3670.4	756	1759.0	1854.0	3518.0	3708.0	849	1777.6	1872.6	3555.2	3745.2
569	1721.6	1816.6	3443.2	3633.2	663	1740.4	1835.4	3480.8	3670.8	757	1759.2	1854.2	3518.4	3708.4	850	1777.8	1872.8	3555.6	3745.6
570	1721.8	1816.8	3443.6	3633.6	664	1740.6	1835.6	3481.2	3671.2	758	1759.4	1854.4	3518.8	3708.8	851	1778.0	1873.0	3556.0	3746.0
571	1722.0	1817.0	3444.0	3634.0	665	1740.8	1835.8	3481.6	3671.6	759	1759.6	1854.6	3519.2	3709.2	852	1778.2	1873.2	3556.4	3746.4
572	1722.2	1817.2	3444.4	3634.4	666	1741.0	1836.0	3482.0	3672.0	760	1759.8	1854.8	3519.6	3709.6	853	1778.4	1873.4	3556.8	3746.8
573	1722.4	1817.4	3444.8	3634.8	667	1741.2	1836.2	3482.4	3672.4	761	1760.0	1855.0	3520.0	3710.0	854	1778.6	1873.6	3557.2	3747.2
574	1722.6	1817.6	3445.2	3635.2	668	1741.4	1836.4	3482.8	3672.8	762	1760.2	1855.2	3520.4	3710.4	855	1778.8	1873.8	3557.6	3747.6
575	1722.8	1817.8	3445.6	3635.6	669	1741.6	1836.6	3483.2	3673.2	763	1760.4	1855.4	3520.8	3710.8	856	1779.0	1874.0	3558.0	3748.0
576	1723.0	1818.0	3446.0	3636.0	670	1741.8	1836.8	3483.6	3673.6	764	1760.6	1855.6	3521.2	3711.2	857	1779.2	1874.2	3558.4	3748.4
577	1723.2	1818.2	3446.4	3636.4	671	1742.0	1837.0	3484.0	3674.0	765	1760.8	1855.8	3521.6	3711.6	858	1779.4	1874.4	3558.8	3748.8
578	1723.4	1818.4	3446.8	3636.8	672	1742.2	1837.2	3484.4	3674.4	766	1761.0	1856.0	3522.0	3712.0	859	1779.6	1874.6	3559.2	3749.2
579	1723.6	1818.6	3447.2	3637.2	673	1742.4	1837.4	3484.8	3674.8	767	1761.2	1856.2	3522.4	3712.4	860	1779.8	1874.8	3559.6	3749.6
580	1723.8	1818.8	3447.6	3637.6	674	1742.6	1837.6	3485.2	3675.2	768	1761.4	1856.4	3522.8	3712.8	861	1780.0	1875.0	3560.0	3750.0
581	1724.0	1819.0	3448.0	3638.0	675	1742.8	1837.8	3485.6	3675.6	769	1761.6	1856.6	3523.2	3713.2	862	1780.2	1875.2	3560.4	3750.4
582	1724.2	1819.2	3448.4	3638.4	676	1743.0	1838.0	3486.0	3676.0	770	1761.8	1856.8	3523.6	3713.6	863	1780.4	1875.4	3560.8	3750.8
583	1724.4	1819.4	3448.8	3638.8	677	1743.2	1838.2	3486.4	3676.4	771	1762.0	1857.0	3524.0	3714.0	864	1780.6	1875.6	3561.2	3751.2
584	1724.6	1819.6	3449.2	3639.2	678	1743.4	1838.4	3486.8	3676.8	772	1762.2	1857.2	3524.4	3714.4	865	1780.8	1875.8	3561.6	3751.6
585	1724.8	1819.8	3449.6	3639.6	679	1743.6	1838.6	3487.2	3677.2	773	1762.4	1857.4	3524.8	3714.8	866	1781.0	1876.0	3562.0	3752.0
586	1725.0	1820.0	3450.0	3640.0	680	1743.8	1838.8	3487.6	3677.6	774	1762.6	1857.6	3525.2	3715.2	867	1781.2	1876.2	3562.4	3752.4
587	1725.2	1820.2	3450.4	3640.4	681	1744.0	1839.0	3488.0	3678.0	775	1762.8	1857.8	3525.6	3715.6	868	1781.4	1876.4	3562.8	3752.8
588	1725.4	1820.4	3450.8	3640.8	682	1744.2	1839.2	3488.4	3678.4	776	1763.0	1858.0	3526.0	3716.0	869	1781.6	1876.6	3563.2	3753.2
589	1725.6	1820.6	3451.2	3641.2	683	1744.4	1839.4	3488.8	3678.8	777	1763.2	1858.2	3526.4	3716.4	870	1781.8	1876.8	3563.6	3753.6
590	1725.8	1820.8	3451.6	3641.6	684	1744.6	1839.6	3489.2	3679.2	778	1763.4	1858.4	3526.8	3716.8	871	1782.0	1877.0	3564.0	3754.0
591	1726.0	1821.0	3452.0	3642.0	685	1744.8	1839.8	3489.6	3679.6	779	1763.6	1858.6	3527.2	3717.2	872	1782.2	1877.2	3564.4	3754.4
592	1726.2	1821.2	3452.4	3642.4	686	1745.0	1840.0	3490.0	3680.0	780	1763.8	1858.8	3527.6	3717.6	873	1782.4	1877.4	3564.8	3754.8
593	1726.4	1821.4	3452.8	3642.8	687	1745.2	1840.2	3490.4	3680.4	781	1764.0	1859.0	3528.0	3718.0	874	1782.6	1877.6	3565.2	3755.2
594	1726.6	1821.6	3453.2	3643.2	688	1745.4	1840.4	3490.8	3680.8	782	1764.2	1859.2	3528.4	3718.4	875	1782.8	1877.8	3565.6	3755.6
595	1726.8	1821.8	3453.6	3643.6	689	1745.6	1840.6	3491.2	3681.2	783	1764.4	1859.4	3528.8	3718.8	876	1783.0	1878.0	3566.0	3756.0
596	1727.0	1822.0	3454.0	3644.0	690	1745.8	1840.8	3491.6	3681.6	784	1764.6	1859.6	3529.2	3719.2	877	1783.2	1878.2	3566.4	3756.4
597	1727.2	1822.2	3454.4	3644.4	691	1746.0	1841.0	3492.0	3682.0	785	1764.8	1859.8	3529.6	3719.6	878	1783.4	1878.4	3566.8	3756.8
598	1727.4	1822.4	3454.8	3644.8	692	1746.2	1841.2	3492.4	3682.4	786	1765.0	1860.0	3530.0	3720.0	879	1783.6	1878.6	3567.2	3757.2
599	1727.6	1822.6	3455.2	3645.2	693	1746.4	1841.4	3492.8	3682.8	787	1765.2	1860.2	3530.4	3720.4	880	1783.8	1878.8	3567.6	3757.6
600	1727.8	1822.8	3455.6	3645.6	694	1746.6	1841.6	3493.2	3683.2	788	1765.4	1860.4	3530.8	3720.8	881	1784.0	1879.0	3568.0	3758.0
601	1728.0	1823.0	3456.0	3646.0	695	1746.8	1841.8	3493.6	3683.6	789	1765.6	1860.6	3531.2	3721.2	882	1784.2	1879.2	3568.4	3758.4
602	1728.2	1823.2	3456.4	3646.4	696	1747.0	1842.0	3494.0	3684.0	790	1765.8	1860.8	3531.6	3721.6	883	1784.4	1879.4	3568.8	3758.8
603	1728.4	1823.4	3456.8	3646.8	697	1747.2	1842.2	3494.4	3684.4	791	1766.0	1861.0	3532.0	3722.0	884	1784.6	1879.6	3569.2	3759.2
604	1728.6	1823.6	3457.2	3647.2	698	1747.4	1842.4	3494.8	3684.8	792	1766.2	1861.2	3532.4	3722.4	885	1784.8	1879.8	3569.6	3759.6
605	1728.8	1823.8	3457.6	3647.6	699	1747.6	1842.6	3495.2	3685.2										

GSM1900 frequencies

CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX	CH	TX	RX	VCO TX	VCO RX
512	1850,2	1930,2	3700,4	3860,4	606	1869,0	1949,0	3738,0	3898,0	700	1887,8	1967,8	3775,6	3935,6	794	1906,6	1986,6	3813,2	3973,2
513	1850,4	1930,4	3700,8	3860,8	607	1869,2	1949,2	3738,4	3898,4	701	1888,0	1968,0	3776,0	3936,0	795	1906,8	1986,8	3813,6	3973,6
514	1850,6	1930,6	3701,2	3861,2	608	1869,4	1949,4	3738,8	3898,8	702	1888,2	1968,2	3776,4	3936,4	796	1907,0	1987,0	3814,0	3974,0
515	1850,8	1930,8	3701,6	3861,6	609	1869,6	1949,6	3739,2	3899,2	703	1888,4	1968,4	3776,8	3936,8	797	1907,2	1987,2	3814,4	3974,4
516	1851,0	1931,0	3702,0	3862,0	610	1869,8	1949,8	3739,6	3899,6	704	1888,6	1968,6	3777,2	3937,2	798	1907,4	1987,4	3814,8	3974,8
517	1851,2	1931,2	3702,4	3862,4	611	1870,0	1950,0	3740,0	3900,0	705	1888,8	1968,8	3777,6	3937,6	799	1907,6	1987,6	3815,2	3975,2
518	1851,4	1931,4	3702,8	3862,8	612	1870,2	1950,2	3740,4	3900,4	706	1889,0	1969,0	3778,0	3938,0	800	1907,8	1987,8	3815,6	3975,6
519	1851,6	1931,6	3703,2	3863,2	613	1870,4	1950,4	3740,8	3900,8	707	1889,2	1969,2	3778,4	3938,4	801	1908,0	1988,0	3816,0	3976,0
520	1851,8	1931,8	3703,6	3863,6	614	1870,6	1950,6	3741,2	3901,2	708	1889,4	1969,4	3778,8	3938,8	802	1908,2	1988,2	3816,4	3976,4
521	1852,0	1932,0	3704,0	3864,0	615	1870,8	1950,8	3741,6	3901,6	709	1889,6	1969,6	3779,2	3939,2	803	1908,4	1988,4	3816,8	3976,8
522	1852,2	1932,2	3704,4	3864,4	616	1871,0	1951,0	3742,0	3902,0	710	1889,8	1969,8	3779,6	3939,6	804	1908,6	1988,6	3817,2	3977,2
523	1852,4	1932,4	3704,8	3864,8	617	1871,2	1951,2	3742,4	3902,4	711	1890,0	1970,0	3780,0	3940,0	805	1908,8	1988,8	3817,6	3977,6
524	1852,6	1932,6	3705,2	3865,2	618	1871,4	1951,4	3742,8	3902,8	712	1890,2	1970,2	3780,4	3940,4	806	1909,0	1989,0	3818,0	3978,0
525	1852,8	1932,8	3705,6	3865,6	619	1871,6	1951,6	3743,2	3903,2	713	1890,4	1970,4	3780,8	3940,8	807	1909,2	1989,2	3818,4	3978,4
526	1853,0	1933,0	3706,0	3866,0	620	1871,8	1951,8	3743,6	3903,6	714	1890,6	1970,6	3781,2	3941,2	808	1909,4	1989,4	3818,8	3978,8
527	1853,2	1933,2	3706,4	3866,4	621	1872,0	1952,0	3744,0	3904,0	715	1890,8	1970,8	3781,6	3941,6	809	1909,6	1989,6	3819,2	3979,2
528	1853,4	1933,4	3706,8	3866,8	622	1872,2	1952,2	3744,4	3904,4	716	1891,0	1971,0	3782,0	3942,0	810	1909,8	1989,8	3819,6	3979,6
529	1853,6	1933,6	3707,2	3867,2	623	1872,4	1952,4	3744,8	3904,8	717	1891,2	1971,2	3782,4	3942,4					
530	1853,8	1933,8	3707,6	3867,6	624	1872,6	1952,6	3745,2	3905,2	718	1891,4	1971,4	3782,8	3942,8					
531	1854,0	1934,0	3708,0	3868,0	625	1872,8	1952,8	3745,6	3905,6	719	1891,6	1971,6	3783,2	3943,2					
532	1854,2	1934,2	3708,4	3868,4	626	1873,0	1953,0	3746,0	3906,0	720	1891,8	1971,8	3783,6	3943,6					
533	1854,4	1934,4	3708,8	3868,8	627	1873,2	1953,2	3746,4	3906,4	721	1892,0	1972,0	3784,0	3944,0					
534	1854,6	1934,6	3709,2	3869,2	628	1873,4	1953,4	3746,8	3906,8	722	1892,2	1972,2	3784,4	3944,4					
535	1854,8	1934,8	3709,6	3869,6	629	1873,6	1953,6	3747,2	3907,2	723	1892,4	1972,4	3784,8	3944,8					
536	1855,0	1935,0	3710,0	3870,0	630	1873,8	1953,8	3747,6	3907,6	724	1892,6	1972,6	3785,2	3945,2					
537	1855,2	1935,2	3710,4	3870,4	631	1874,0	1954,0	3748,0	3908,0	725	1892,8	1972,8	3785,6	3945,6					
538	1855,4	1935,4	3710,8	3870,8	632	1874,2	1954,2	3748,4	3908,4	726	1893,0	1973,0	3786,0	3946,0					
539	1855,6	1935,6	3711,2	3871,2	633	1874,4	1954,4	3748,8	3908,8	727	1893,2	1973,2	3786,4	3946,4					
540	1855,8	1935,8	3711,6	3871,6	634	1874,6	1954,6	3749,2	3909,2	728	1893,4	1973,4	3786,8	3946,8					
541	1856,0	1936,0	3712,0	3872,0	635	1874,8	1954,8	3749,6	3909,6	729	1893,6	1973,6	3787,2	3947,2					
542	1856,2	1936,2	3712,4	3872,4	636	1875,0	1955,0	3750,0	3910,0	730	1893,8	1973,8	3787,6	3947,6					
543	1856,4	1936,4	3712,8	3872,8	637	1875,2	1955,2	3750,4	3910,4	731	1894,0	1974,0	3788,0	3948,0					
544	1856,6	1936,6	3713,2	3873,2	638	1875,4	1955,4	3750,8	3910,8	732	1894,2	1974,2	3788,4	3948,4					
545	1856,8	1936,8	3713,6	3873,6	639	1875,6	1955,6	3751,2	3911,2	733	1894,4	1974,4	3788,8	3948,8					
546	1857,0	1937,0	3714,0	3874,0	640	1875,8	1955,8	3751,6	3911,6	734	1894,6	1974,6	3789,2	3949,2					
547	1857,2	1937,2	3714,4	3874,4	641	1876,0	1956,0	3752,0	3912,0	735	1894,8	1974,8	3789,6	3949,6					
548	1857,4	1937,4	3714,8	3874,8	642	1876,2	1956,2	3752,4	3912,4	736	1895,0	1975,0	3790,0	3950,0					
549	1857,6	1937,6	3715,2	3875,2	643	1876,4	1956,4	3752,8	3912,8	737	1895,2	1975,2	3790,4	3950,4					
550	1857,8	1937,8	3715,6	3875,6	644	1876,6	1956,6	3753,2	3913,2	738	1895,4	1975,4	3790,8	3950,8					
551	1858,0	1938,0	3716,0	3876,0	645	1876,8	1956,8	3753,6	3913,6	739	1895,6	1975,6	3791,2	3951,2					
552	1858,2	1938,2	3716,4	3876,4	646	1877,0	1957,0	3754,0	3914,0	740	1895,8	1975,8	3791,6	3951,6					
553	1858,4	1938,4	3716,8	3876,8	647	1877,2	1957,2	3754,4	3914,4	741	1896,0	1976,0	3792,0	3952,0					
554	1858,6	1938,6	3717,2	3877,2	648	1877,4	1957,4	3754,8	3914,8	742	1896,2	1976,2	3792,4	3952,4					
555	1858,8	1938,8	3717,6	3877,6	649	1877,6	1957,6	3755,2	3915,2	743	1896,4	1976,4	3792,8	3952,8					
556	1859,0	1939,0	3718,0	3878,0	650	1877,8	1957,8	3755,6	3915,6	744	1896,6	1976,6	3793,2	3953,2					
557	1859,2	1939,2	3718,4	3878,4	651	1878,0	1958,0	3756,0	3916,0	745	1896,8	1976,8	3793,6	3953,6					
558	1859,4	1939,4	3718,8	3878,8	652	1878,2	1958,2	3756,4	3916,4	746	1897,0	1977,0	3794,0	3954,0					
559	1859,6	1939,6	3719,2	3879,2	653	1878,4	1958,4	3756,8	3916,8	747	1897,2	1977,2	3794,4	3954,4					
560	1859,8	1939,8	3719,6	3879,6	654	1878,6	1958,6	3757,2	3917,2	748	1897,4	1977,4	3794,8	3954,8					
561	1860,0	1940,0	3720,0	3880,0	655	1878,8	1958,8	3757,6	3917,6	749	1897,6	1977,6	3795,2	3955,2					
562	1860,2	1940,2	3720,4	3880,4	656	1879,0	1959,0	3758,0	3918,0	750	1897,8	1977,8	3795,6	3955,6					
563	1860,4	1940,4	3720,8	3880,8	657	1879,2	1959,2	3758,4	3918,4	751	1898,0	1978,0	3796,0	3956,0					
564	1860,6	1940,6	3721,2	3881,2	658	1879,4	1959,4	3758,8	3918,8	752	1898,2	1978,2	3796,4	3956,4					
565	1860,8	1940,8	3721,6	3881,6	659	1879,6	1959,6	3759,2	3919,2	753	1898,4	1978,4	3796,8	3956,8					
566	1861,0	1941,0	3722,0	3882,0	660	1879,8	1959,8	3759,6	3919,6	754	1898,6	1978,6	3797,2	3957,2					
567	1861,2	1941,2	3722,4	3882,4	661	1880,0	1960,0	3760,0	3920,0	755	1898,8	1978,8	3797,6	3957,6					
568	1861,4	1941,4	3722,8	3882,8	662	1880,2	1960,2	3760,4	3920,4	756	1899,0	1979,0	3798,0	3958,0					
569	1861,6	1941,6	3723,2	3883,2	663	1880,4	1960,4	3760,8	3920,8	757	1899,2	1979,2	3798,4	3958,4					
570	1861,8	1941,8	3723,6	3883,6	664	1880,6	1960,6	3761,2	3921,2	758	1899,4	1979,4	3798,8	3958,8					
571	1862,0	1942,0	3724,0	3884,0	665	1880,8	1960,8	3761,6	3921,6	759	1899,6	1979,6	3799,2	3959,2					
572	1862,2	1942,2	3724,4	3884,4	666	1881,0	1961,0	3762,0	3922,0	760	1899,8	1979,8	3799,6	3959,6					
573	1862,4	1942,4	3724,8	3884,8	667	1881,2	1961,2	3762,4	3922,4	761	1900,0	1980,0	3800,0	3960,0					
574	1862,6	1942,6	3725,2	3885,2	668	1881,4	1961,4	3762,8	3922,8	762	1900,2	1980,2	3800,4	3960,4					
575	1862,8	1942,8	3725,6	3885,6	669	1881,6	1961,6	3763,2	3923,2	763	1900,4	1980,4	3800,8	3960,8					
576	1863,0	1943,0	3726,0	3886,0	670	1881,8	1961,8	3763,6	3923,6	764	1900,6	1980,6	3801,2	3961,2					
577	1863,2	1943,2	3726,4	3886,4	671	1882,0	1962,0	3764,0	3924,0	765	1900,8	1980,8	3801,6	3961,6					
578	1863,4	1943,4	3726,8	3886,8	672	1882,2	1962,2	3764,4	3924,4	766	1901,0	1981,0	3802,0	3962,0					
579	1863,6	1943,6	3727,2	3887,2	673	1882,4	1962,4	3764,8	3924,8	767	1901,2	1981,2	3802,4	3962,4					
580	1863,8	1943,8	3727,6	3887,6	674	1882,6	1962,6	3765,2	3925,2	768	1901,4	1981,4	3802,8	3962,8					
581	1864,0	1944,0	3728,0	3888,0	675	1882,8	1962,8	3765,6	3925,6	769	1901,6	1981,6	3803,2	3963,2					
582	1864,2	1944,2	3728,4	3888,4	676	1883,0	1963,0	3766,0	3926,0	770	1901,8	1981,8	3803,6	3963,6					
583	1864,4	1944,4	3728,8	3888,8	677	1883,2	1963,2	3766,4	3926,4	771	1902,0	1982,0	3804,0	3964,0					
584	1864,6	1944,6	3729,2	3889,2	678	1883,4	1963,4	3766,8	3926,8	772	1902,2	1982,2	3804,4	3964,4					
585	1864,8	1944,8	3729,6	3889,6	679	1883,6	1963,6	3767,2	3927,2	773	1902,4	1982,4	3804,8	3964,8					
586	1865,0	1945,0	3730,0	3890,0	680	1883,8	1963,8	3767,6	3927,6	774	1902,6	1982,6	3805,2	3965,2					
587	1865,2	1945,2	3730,4	3890,4	681	1884,0	1964,0	3768,0	3928,0	775	1902,8	1982,8	3805,6	3965,6					
588	1865,4	1945,4	3730,8	3890,8	682	1884,2	1964,2	3768,4	3928,4	776	1903,0	1983,0	3806,0	3966,0					
589	1865,6	1945,6	3731,2	3891,2	683	1884,4	1964,4	3768,8	3928,8	777	1903,2	1983,2	3806,4	3966,4					
590	1865,8	1945,8	3731,6	3891,6	684	1884,6	1964,6	3769,2	3929,2	778	1903,4	1983,4	3806,8	3966,8					
591	1866,0	1946,0	3732,0	3892,0	685	1884,8	1964,8	3769,6	3929,6	779	1903,6	1983,6	3807,2	3967,2					
592	1866,2	1946,2	3732,4	3892,4	686	1885,0	1965,0	3770,0	3930,0	780	1903,8	1983,8	3807,6	3967,6					
593	1866,4	1946,4	3732,8	3892,8	687	1885,2	1965,2	3770,4	3930,4	781	1904,0	1984,0	3808,0	3968,0					
594	1866,6	1946,6	3733,2	3893,2	688	1885,4	1965,4	3770,8	3930,8	782	1904,2	1984,2	3808,4	3968,4					
595	1866,8	1946,8	3733,6	3893,6	689	1885,6	1965,6	3771,2	3931,2	783	1904,4	1984,4	3808,8	3968,8					
596	1867,0	1947,0	3734,0	3894,0	690	1885,8	1965,8	3771,6	3931,6	784	1904,6	1984,6	3809,2	3969,2					
597	1867,2	1947,2	3734,4	3894,4	691	1886,0	1966,0	3772,0	3932,0	785	1904,8	1984,8	3809,6	3969,6					
598	1867,4	1947,4	3734,8	3894,8	692	1886,2	1966,2	3772,4	3932,4	786	1905,0	1985,0	3810,0	3970,0					
599	1867,6	1947,6	3735,2	3895,2	693	1886,4	1966,4	3772,8	3932,8	787	1905,2	1985,2	3810,4	3970,4					
600	1867,8	1947,8	3735,6	3895,6	694	1886,6	1966,6	3773,2	3933,2	788	1905,4	1985,4	3810,8	3970,8					
601	1868,0	1948,0	3736,0	3896,0	695	1886,8	1966,8	3773,6	3933,6	789	1905,6	1985,6	3811,2	3971,2					
602	1868,2	1948,2	3736,4	3896,4	696	1887,0	1967,0	3774,0	3934,0	790	1905,8	1985,8	3811,6	3971,6					
603	1868,4	1948,4	3736,8	3896,8	697	1887,2	1967,2	3774,4	3934,4	791	1906,0	1986,0	3812,0	3972,0					
604	1868,6	1948,6	3737,2	3897,2	698	1887,4	1967,4	3774,8	3934,8	792	1906,2	1986,2	3812,4	3972,4					
605	1868,8	1948,8	3737,6	3897,6	699	1887,6	1967,6	3775,2	3935,2	793	1906,4	1986,4	3812,8	3972,8					

WCDMA 2100 Rx frequencies

Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX	Ch	RX	VCO RX
10562	2112.4	4224.8	10625	2125	4250	10688	2137.6	4275.2	10751	2150.2	4300.4	10814	2162.8	4325.6
10563	2112.6	4225.2	10626	2125.2	4250.4	10689	2137.8	4275.6	10752	2150.4	4300.8	10815	2163	4326
10564	2112.8	4225.6	10627	2125.4	4250.8	10690	2138	4276	10753	2150.6	4301.2	10816	2163.2	4326.4
10565	2113	4226	10628	2125.6	4251.2	10691	2138.2	4276.4	10754	2150.8	4301.6	10817	2163.4	4326.8
10566	2113.2	4226.4	10629	2125.8	4251.6	10692	2138.4	4276.8	10755	2151	4302	10818	2163.6	4327.2
10567	2113.4	4226.8	10630	2126	4252	10693	2138.6	4277.2	10756	2151.2	4302.4	10819	2163.8	4327.6
10568	2113.6	4227.2	10631	2126.2	4252.4	10694	2138.8	4277.6	10757	2151.4	4302.8	10820	2164	4328
10569	2113.8	4227.6	10632	2126.4	4252.8	10695	2139	4278	10758	2151.6	4303.2	10821	2164.2	4328.4
10570	2114	4228	10633	2126.6	4253.2	10696	2139.2	4278.4	10759	2151.8	4303.6	10822	2164.4	4328.8
10571	2114.2	4228.4	10634	2126.8	4253.6	10697	2139.4	4278.8	10760	2152	4304	10823	2164.6	4329.2
10572	2114.4	4228.8	10635	2127	4254	10698	2139.6	4279.2	10761	2152.2	4304.4	10824	2164.8	4329.6
10573	2114.6	4229.2	10636	2127.2	4254.4	10699	2139.8	4279.6	10762	2152.4	4304.8	10825	2165	4330
10574	2114.8	4229.6	10637	2127.4	4254.8	10700	2140	4280	10763	2152.6	4305.2	10826	2165.2	4330.4
10575	2115	4230	10638	2127.6	4255.2	10701	2140.2	4280.4	10764	2152.8	4305.6	10827	2165.4	4330.8
10576	2115.2	4230.4	10639	2127.8	4255.6	10702	2140.4	4280.8	10765	2153	4306	10828	2165.6	4331.2
10577	2115.4	4230.8	10640	2128	4256	10703	2140.6	4281.2	10766	2153.2	4306.4	10829	2165.8	4331.6
10578	2115.6	4231.2	10641	2128.2	4256.4	10704	2140.8	4281.6	10767	2153.4	4306.8	10830	2166	4332
10579	2115.8	4231.6	10642	2128.4	4256.8	10705	2141	4282	10768	2153.6	4307.2	10831	2166.2	4332.4
10580	2116	4232	10643	2128.6	4257.2	10706	2141.2	4282.4	10769	2153.8	4307.6	10832	2166.4	4332.8
10581	2116.2	4232.4	10644	2128.8	4257.6	10707	2141.4	4282.8	10770	2154	4308	10833	2166.6	4333.2
10582	2116.4	4232.8	10645	2129	4258	10708	2141.6	4283.2	10771	2154.2	4308.4	10834	2166.8	4333.6
10583	2116.6	4233.2	10646	2129.2	4258.4	10709	2141.8	4283.6	10772	2154.4	4308.8	10835	2167	4334
10584	2116.8	4233.6	10647	2129.4	4258.8	10710	2142	4284	10773	2154.6	4309.2	10836	2167.2	4334.4
10585	2117	4234	10648	2129.6	4259.2	10711	2142.2	4284.4	10774	2154.8	4309.6	10837	2167.4	4334.8
10586	2117.2	4234.4	10649	2129.8	4259.6	10712	2142.4	4284.8	10775	2155	4310	10838	2167.6	4335.2
10587	2117.4	4234.8	10650	2130	4260	10713	2142.6	4285.2	10776	2155.2	4310.4			
10588	2117.6	4235.2	10651	2130.2	4260.4	10714	2142.8	4285.6	10777	2155.4	4310.8			
10589	2117.8	4235.6	10652	2130.4	4260.8	10715	2143	4286	10778	2155.6	4311.2			
10590	2118	4236	10653	2130.6	4261.2	10716	2143.2	4286.4	10779	2155.8	4311.6			
10591	2118.2	4236.4	10654	2130.8	4261.6	10717	2143.4	4286.8	10780	2156	4312			
10592	2118.4	4236.8	10655	2131	4262	10718	2143.6	4287.2	10781	2156.2	4312.4			
10593	2118.6	4237.2	10656	2131.2	4262.4	10719	2143.8	4287.6	10782	2156.4	4312.8			
10594	2118.8	4237.6	10657	2131.4	4262.8	10720	2144	4288	10783	2156.6	4313.2			
10595	2119	4238	10658	2131.6	4263.2	10721	2144.2	4288.4	10784	2156.8	4313.6			
10596	2119.2	4238.4	10659	2131.8	4263.6	10722	2144.4	4288.8	10785	2157	4314			
10597	2119.4	4238.8	10660	2132	4264	10723	2144.6	4289.2	10786	2157.2	4314.4			
10598	2119.6	4239.2	10661	2132.2	4264.4	10724	2144.8	4289.6	10787	2157.4	4314.8			
10599	2119.8	4239.6	10662	2132.4	4264.8	10725	2145	4290	10788	2157.6	4315.2			
10600	2120	4240	10663	2132.6	4265.2	10726	2145.2	4290.4	10789	2157.8	4315.6			
10601	2120.2	4240.4	10664	2132.8	4265.6	10727	2145.4	4290.8	10790	2158	4316			
10602	2120.4	4240.8	10665	2133	4266	10728	2145.6	4291.2	10791	2158.2	4316.4			
10603	2120.6	4241.2	10666	2133.2	4266.4	10729	2145.8	4291.6	10792	2158.4	4316.8			
10604	2120.8	4241.6	10667	2133.4	4266.8	10730	2146	4292	10793	2158.6	4317.2			
10605	2121	4242	10668	2133.6	4267.2	10731	2146.2	4292.4	10794	2158.8	4317.6			
10606	2121.2	4242.4	10669	2133.8	4267.6	10732	2146.4	4292.8	10795	2159	4318			
10607	2121.4	4242.8	10670	2134	4268	10733	2146.6	4293.2	10796	2159.2	4318.4			
10608	2121.6	4243.2	10671	2134.2	4268.4	10734	2146.8	4293.6	10797	2159.4	4318.8			
10609	2121.8	4243.6	10672	2134.4	4268.8	10735	2147	4294	10798	2159.6	4319.2			
10610	2122	4244	10673	2134.6	4269.2	10736	2147.2	4294.4	10799	2159.8	4319.6			
10611	2122.2	4244.4	10674	2134.8	4269.6	10737	2147.4	4294.8	10800	2160	4320			
10612	2122.4	4244.8	10675	2135	4270	10738	2147.6	4295.2	10801	2160.2	4320.4			
10613	2122.6	4245.2	10676	2135.2	4270.4	10739	2147.8	4295.6	10802	2160.4	4320.8			
10614	2122.8	4245.6	10677	2135.4	4270.8	10740	2148	4296	10803	2160.6	4321.2			
10615	2123	4246	10678	2135.6	4271.2	10741	2148.2	4296.4	10804	2160.8	4321.6			
10616	2123.2	4246.4	10679	2135.8	4271.6	10742	2148.4	4296.8	10805	2161	4322			
10617	2123.4	4246.8	10680	2136	4272	10743	2148.6	4297.2	10806	2161.2	4322.4			
10618	2123.6	4247.2	10681	2136.2	4272.4	10744	2148.8	4297.6	10807	2161.4	4322.8			
10619	2123.8	4247.6	10682	2136.4	4272.8	10745	2149	4298	10808	2161.6	4323.2			
10620	2124	4248	10683	2136.6	4273.2	10746	2149.2	4298.4	10809	2161.8	4323.6			
10621	2124.2	4248.4	10684	2136.8	4273.6	10747	2149.4	4298.8	10810	2162	4324			
10622	2124.4	4248.8	10685	2137	4274	10748	2149.6	4299.2	10811	2162.2	4324.4			
10623	2124.6	4249.2	10686	2137.2	4274.4	10749	2149.8	4299.6	10812	2162.4	4324.8			
10624	2124.8	4249.6	10687	2137.4	4274.8	10750	2150	4300	10813	2162.6	4325.2			

WCDMA 2100 Tx frequencies

Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx	Ch	Tx	VCO Tx
9612	1922.4	3844.8	9671	1934.2	3868.4	9730	1946	3892	9789	1957.8	3915.6	9848	1969.6	3939.2
9613	1922.6	3845.2	9672	1934.4	3868.8	9731	1946.2	3892.4	9790	1958	3916	9849	1969.8	3939.6
9614	1922.8	3845.6	9673	1934.6	3869.2	9732	1946.4	3892.8	9791	1958.2	3916.4	9850	1970	3940
9615	1923	3846	9674	1934.8	3869.6	9733	1946.6	3893.2	9792	1958.4	3916.8	9851	1970.2	3940.4
9616	1923.2	3846.4	9675	1935	3870	9734	1946.8	3893.6	9793	1958.6	3917.2	9852	1970.4	3940.8
9617	1923.4	3846.8	9676	1935.2	3870.4	9735	1947	3894	9794	1958.8	3917.6	9853	1970.6	3941.2
9618	1923.6	3847.2	9677	1935.4	3870.8	9736	1947.2	3894.4	9795	1959	3918	9854	1970.8	3941.6
9619	1923.8	3847.6	9678	1935.6	3871.2	9737	1947.4	3894.8	9796	1959.2	3918.4	9855	1971	3942
9620	1924	3848	9679	1935.8	3871.6	9738	1947.6	3895.2	9797	1959.4	3918.8	9856	1971.2	3942.4
9621	1924.2	3848.4	9680	1936	3872	9739	1947.8	3895.6	9798	1959.6	3919.2	9857	1971.4	3942.8
9622	1924.4	3848.8	9681	1936.2	3872.4	9740	1948	3896	9799	1959.8	3919.6	9858	1971.6	3943.2
9623	1924.6	3849.2	9682	1936.4	3872.8	9741	1948.2	3896.4	9800	1960	3920	9859	1971.8	3943.6
9624	1924.8	3849.6	9683	1936.6	3873.2	9742	1948.4	3896.8	9801	1960.2	3920.4	9860	1972	3944
9625	1925	3850	9684	1936.8	3873.6	9743	1948.6	3897.2	9802	1960.4	3920.8	9861	1972.2	3944.4
9626	1925.2	3850.4	9685	1937	3874	9744	1948.8	3897.6	9803	1960.6	3921.2	9862	1972.4	3944.8
9627	1925.4	3850.8	9686	1937.2	3874.4	9745	1949	3898	9804	1960.8	3921.6	9863	1972.6	3945.2
9628	1925.6	3851.2	9687	1937.4	3874.8	9746	1949.2	3898.4	9805	1961	3922	9864	1972.8	3945.6
9629	1925.8	3851.6	9688	1937.6	3875.2	9747	1949.4	3898.8	9806	1961.2	3922.4	9865	1973	3946
9630	1926	3852	9689	1937.8	3875.6	9748	1949.6	3899.2	9807	1961.4	3922.8	9866	1973.2	3946.4
9631	1926.2	3852.4	9690	1938	3876	9749	1949.8	3899.6	9808	1961.6	3923.2	9867	1973.4	3946.8
9632	1926.4	3852.8	9691	1938.2	3876.4	9750	1950	3900	9809	1961.8	3923.6	9868	1973.6	3947.2
9633	1926.6	3853.2	9692	1938.4	3876.8	9751	1950.2	3900.4	9810	1962	3924	9869	1973.8	3947.6
9634	1926.8	3853.6	9693	1938.6	3877.2	9752	1950.4	3900.8	9811	1962.2	3924.4	9870	1974	3948
9635	1927	3854	9694	1938.8	3877.6	9753	1950.6	3901.2	9812	1962.4	3924.8	9871	1974.2	3948.4
9636	1927.2	3854.4	9695	1939	3878	9754	1950.8	3901.6	9813	1962.6	3925.2	9872	1974.4	3948.8
9637	1927.4	3854.8	9696	1939.2	3878.4	9755	1951	3902	9814	1962.8	3925.6	9873	1974.6	3949.2
9638	1927.6	3855.2	9697	1939.4	3878.8	9756	1951.2	3902.4	9815	1963	3926	9874	1974.8	3949.6
9639	1927.8	3855.6	9698	1939.6	3879.2	9757	1951.4	3902.8	9816	1963.2	3926.4	9875	1975	3950
9640	1928	3856	9699	1939.8	3879.6	9758	1951.6	3903.2	9817	1963.4	3926.8	9876	1975.2	3950.4
9641	1928.2	3856.4	9700	1940	3880	9759	1951.8	3903.6	9818	1963.6	3927.2	9877	1975.4	3950.8
9642	1928.4	3856.8	9701	1940.2	3880.4	9760	1952	3904	9819	1963.8	3927.6	9878	1975.6	3951.2
9643	1928.6	3857.2	9702	1940.4	3880.8	9761	1952.2	3904.4	9820	1964	3928	9879	1975.8	3951.6
9644	1928.8	3857.6	9703	1940.6	3881.2	9762	1952.4	3904.8	9821	1964.2	3928.4	9880	1976	3952
9645	1929	3858	9704	1940.8	3881.6	9763	1952.6	3905.2	9822	1964.4	3928.8	9881	1976.2	3952.4
9646	1929.2	3858.4	9705	1941	3882	9764	1952.8	3905.6	9823	1964.6	3929.2	9882	1976.4	3952.8
9647	1929.4	3858.8	9706	1941.2	3882.4	9765	1953	3906	9824	1964.8	3929.6	9883	1976.6	3953.2
9648	1929.6	3859.2	9707	1941.4	3882.8	9766	1953.2	3906.4	9825	1965	3930	9884	1976.8	3953.6
9649	1929.8	3859.6	9708	1941.6	3883.2	9767	1953.4	3906.8	9826	1965.2	3930.4	9885	1977	3954
9650	1930	3860	9709	1941.8	3883.6	9768	1953.6	3907.2	9827	1965.4	3930.8	9886	1977.2	3954.4
9651	1930.2	3860.4	9710	1942	3884	9769	1953.8	3907.6	9828	1965.6	3931.2	9887	1977.4	3954.8
9652	1930.4	3860.8	9711	1942.2	3884.4	9770	1954	3908	9829	1965.8	3931.6	9888	1977.6	3955.2
9653	1930.6	3861.2	9712	1942.4	3884.8	9771	1954.2	3908.4	9830	1966	3932			
9654	1930.8	3861.6	9713	1942.6	3885.2	9772	1954.4	3908.8	9831	1966.2	3932.4			
9655	1931	3862	9714	1942.8	3885.6	9773	1954.6	3909.2	9832	1966.4	3932.8			
9656	1931.2	3862.4	9715	1943	3886	9774	1954.8	3909.6	9833	1966.6	3933.2			
9657	1931.4	3862.8	9716	1943.2	3886.4	9775	1955	3910	9834	1966.8	3933.6			
9658	1931.6	3863.2	9717	1943.4	3886.8	9776	1955.2	3910.4	9835	1967	3934			
9659	1931.8	3863.6	9718	1943.6	3887.2	9777	1955.4	3910.8	9836	1967.2	3934.4			
9660	1932	3864	9719	1943.8	3887.6	9778	1955.6	3911.2	9837	1967.4	3934.8			
9661	1932.2	3864.4	9720	1944	3888	9779	1955.8	3911.6	9838	1967.6	3935.2			
9662	1932.4	3864.8	9721	1944.2	3888.4	9780	1956	3912	9839	1967.8	3935.6			
9663	1932.6	3865.2	9722	1944.4	3888.8	9781	1956.2	3912.4	9840	1968	3936			
9664	1932.8	3865.6	9723	1944.6	3889.2	9782	1956.4	3912.8	9841	1968.2	3936.4			
9665	1933	3866	9724	1944.8	3889.6	9783	1956.6	3913.2	9842	1968.4	3936.8			
9666	1933.2	3866.4	9725	1945	3890	9784	1956.8	3913.6	9843	1968.6	3937.2			
9667	1933.4	3866.8	9726	1945.2	3890.4	9785	1957	3914	9844	1968.8	3937.6			
9668	1933.6	3867.2	9727	1945.4	3890.8	9786	1957.2	3914.4	9845	1969	3938			
9669	1933.8	3867.6	9728	1945.6	3891.2	9787	1957.4	3914.8	9846	1969.2	3938.4			
9670	1934	3868	9729	1945.8	3891.6	9788	1957.6	3915.2	9847	1969.4	3938.8			

WCDMA V (850) frequencies

TX CH	RX CH	TX	RX	VCO TX	VCO RX
4132	4357	826.4	871.4	3305.6	3485.6
782	1007	826.5	871.5	3306.0	3486.0
4133	4358	826.6	871.6	3306.4	3486.4
4134	4359	826.8	871.8	3307.2	3487.2
4135	4360	827.0	872.0	3308.0	3488.0
4136	4361	827.2	872.2	3308.8	3488.8
4137	4362	827.4	872.4	3309.6	3489.6
787	1012	827.5	872.5	3310.0	3490.0
4138	4363	827.6	872.6	3310.4	3490.4
4139	4364	827.8	872.8	3311.2	3491.2
4140	4365	828.0	873.0	3312.0	3492.0
4141	4366	828.2	873.2	3312.8	3492.8
4142	4367	828.4	873.4	3313.6	3493.6
4143	4368	828.6	873.6	3314.4	3494.4
4144	4369	828.8	873.8	3315.2	3495.2
4145	4370	829.0	874.0	3316.0	3496.0
4146	4371	829.2	874.2	3316.8	3496.8
4147	4372	829.4	874.4	3317.6	3497.6
4148	4373	829.6	874.6	3318.4	3498.4
4149	4374	829.8	874.8	3319.2	3499.2
4150	4375	830.0	875.0	3320.0	3500.0
4151	4376	830.2	875.2	3320.8	3500.8
4152	4377	830.4	875.4	3321.6	3501.6
4153	4378	830.6	875.6	3322.4	3502.4
4154	4379	830.8	875.8	3323.2	3503.2
4155	4380	831.0	876.0	3324.0	3504.0
4156	4381	831.2	876.2	3324.8	3504.8
4157	4382	831.4	876.4	3325.6	3505.6
807	1032	831.5	876.5	3326.0	3506.0
4158	4383	831.6	876.6	3326.4	3506.4
4159	4384	831.8	876.8	3327.2	3507.2
4160	4385	832.0	877.0	3328.0	3508.0
4161	4386	832.2	877.2	3328.8	3508.8
4162	4387	832.4	877.4	3329.6	3509.6
812	1037	832.5	877.5	3330.0	3510.0
4163	4388	832.6	877.6	3330.4	3510.4
4164	4389	832.8	877.8	3331.2	3511.2
4165	4390	833.0	878.0	3332.0	3512.0
4166	4391	833.2	878.2	3332.8	3512.8
4167	4392	833.4	878.4	3333.6	3513.6
4168	4393	833.6	878.6	3334.4	3514.4
4169	4394	833.8	878.8	3335.2	3515.2
4170	4395	834.0	879.0	3336.0	3516.0
4171	4396	834.2	879.2	3336.8	3516.8
4172	4397	834.4	879.4	3337.6	3517.6
4173	4398	834.6	879.6	3338.4	3518.4
4174	4399	834.8	879.8	3339.2	3519.2
4175	4400	835.0	880.0	3340.0	3520.0
4176	4401	835.2	880.2	3340.8	3520.8
4177	4402	835.4	880.4	3341.6	3521.6
4178	4403	835.6	880.6	3342.4	3522.4
4179	4404	835.8	880.8	3343.2	3523.2
4180	4405	836.0	881.0	3344.0	3524.0
4181	4406	836.2	881.2	3344.8	3524.8

TX CH	RX CH	TX	RX	VCO TX	VCO RX
4182	4407	836.4	881.4	3345.6	3525.6
4183	4408	836.6	881.6	3346.4	3526.4
4184	4409	836.8	881.8	3347.2	3527.2
4185	4410	837.0	882.0	3348.0	3528.0
4186	4411	837.2	882.2	3348.8	3528.8
4187	4412	837.4	882.4	3349.6	3529.6
837	1062	837.5	882.5	3350.0	3530.0
4188	4413	837.6	882.6	3350.4	3530.4
4189	4414	837.8	882.8	3351.2	3531.2
4190	4415	838.0	883.0	3352.0	3532.0
4191	4416	838.2	883.2	3352.8	3532.8
4192	4417	838.4	883.4	3353.6	3533.6
4193	4418	838.6	883.6	3354.4	3534.4
4194	4419	838.8	883.8	3355.2	3535.2
4195	4420	839.0	884.0	3356.0	3536.0
4196	4421	839.2	884.2	3356.8	3536.8
4197	4422	839.4	884.4	3357.6	3537.6
4198	4423	839.6	884.6	3358.4	3538.4
4199	4424	839.8	884.8	3359.2	3539.2
4200	4425	840.0	885.0	3360.0	3540.0
4201	4426	840.2	885.2	3360.8	3540.8
4202	4427	840.4	885.4	3361.6	3541.6
4203	4428	840.6	885.6	3362.4	3542.4
4204	4429	840.8	885.8	3363.2	3543.2
4205	4430	841.0	886.0	3364.0	3544.0
4206	4431	841.2	886.2	3364.8	3544.8
4207	4432	841.4	886.4	3365.6	3545.6
4208	4433	841.6	886.6	3366.4	3546.4
4209	4434	841.8	886.8	3367.2	3547.2
4210	4435	842.0	887.0	3368.0	3548.0
4211	4436	842.2	887.2	3368.8	3548.8
4212	4437	842.4	887.4	3369.6	3549.6
862	1087	842.5	887.5	3370.0	3550.0
4213	4438	842.6	887.6	3370.4	3550.4
4214	4439	842.8	887.8	3371.2	3551.2
4215	4440	843.0	888.0	3372.0	3552.0
4216	4441	843.2	888.2	3372.8	3552.8
4217	4442	843.4	888.4	3373.6	3553.6
4218	4443	843.6	888.6	3374.4	3554.4
4219	4444	843.8	888.8	3375.2	3555.2
4220	4445	844.0	889.0	3376.0	3556.0
4221	4446	844.2	889.2	3376.8	3556.8
4222	4447	844.4	889.4	3377.6	3557.6
4223	4448	844.6	889.6	3378.4	3558.4
4224	4449	844.8	889.8	3379.2	3559.2
4225	4450	845.0	890.0	3380.0	3560.0
4226	4451	845.2	890.2	3380.8	3560.8
4227	4452	845.4	890.4	3381.6	3561.6
4228	4453	845.6	890.6	3382.4	3562.4
4229	4454	845.8	890.8	3383.2	3563.2
4230	4455	846.0	891.0	3384.0	3564.0
4231	4456	846.2	891.2	3384.8	3564.8
4232	4457	846.4	891.4	3385.6	3565.6
4233	4458	846.6	891.6	3386.4	3566.4

WCDMA VIII (900) frequencies

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2712	882,4	3529,6	2937	927,4	3709,6
2713	882,6	3530,4	2938	927,6	3710,4
2714	882,8	3531,2	2939	927,8	3711,2
2715	883	3532	2940	928	3712
2716	883,2	3532,8	2941	928,2	3712,8
2717	883,4	3533,6	2942	928,4	3713,6
2718	883,6	3534,4	2943	928,6	3714,4
2719	883,8	3535,2	2944	928,8	3715,2
2720	884	3536	2945	929	3716
2721	884,2	3536,8	2946	929,2	3716,8
2722	884,4	3537,6	2947	929,4	3717,6
2723	884,6	3538,4	2948	929,6	3718,4
2724	884,8	3539,2	2949	929,8	3719,2
2725	885	3540	2950	930	3720
2726	885,2	3540,8	2951	930,2	3720,8
2727	885,4	3541,6	2952	930,4	3721,6
2728	885,6	3542,4	2953	930,6	3722,4
2729	885,8	3543,2	2954	930,8	3723,2
2730	886	3544	2955	931	3724
2731	886,2	3544,8	2956	931,2	3724,8
2732	886,4	3545,6	2957	931,4	3725,6
2733	886,6	3546,4	2958	931,6	3726,4
2734	886,8	3547,2	2959	931,8	3727,2
2735	887	3548	2960	932	3728
2736	887,2	3548,8	2961	932,2	3728,8
2737	887,4	3549,6	2962	932,4	3729,6
2738	887,6	3550,4	2963	932,6	3730,4
2739	887,8	3551,2	2964	932,8	3731,2
2740	888	3552	2965	933	3732
2741	888,2	3552,8	2966	933,2	3732,8
2742	888,4	3553,6	2967	933,4	3733,6
2743	888,6	3554,4	2968	933,6	3734,4
2744	888,8	3555,2	2969	933,8	3735,2

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2745	889	3556	2970	934	3736
2746	889,2	3556,8	2971	934,2	3736,8
2747	889,4	3557,6	2972	934,4	3737,6
2748	889,6	3558,4	2973	934,6	3738,4
2749	889,8	3559,2	2974	934,8	3739,2
2750	890	3560	2975	935	3740
2751	890,2	3560,8	2976	935,2	3740,8
2752	890,4	3561,6	2977	935,4	3741,6
2753	890,6	3562,4	2978	935,6	3742,4
2754	890,8	3563,2	2979	935,8	3743,2
2755	891	3564	2980	936	3744
2756	891,2	3564,8	2981	936,2	3744,8
2757	891,4	3565,6	2982	936,4	3745,6
2758	891,6	3566,4	2983	936,6	3746,4
2759	891,8	3567,2	2984	936,8	3747,2
2760	892	3568	2985	937	3748
2761	892,2	3568,8	2986	937,2	3748,8
2762	892,4	3569,6	2987	937,4	3749,6
2763	892,6	3570,4	2988	937,6	3750,4
2764	892,8	3571,2	2989	937,8	3751,2
2765	893	3572	2990	938	3752
2766	893,2	3572,8	2991	938,2	3752,8
2767	893,4	3573,6	2992	938,4	3753,6
2768	893,6	3574,4	2993	938,6	3754,4
2769	893,8	3575,2	2994	938,8	3755,2
2770	894	3576	2995	939	3756
2771	894,2	3576,8	2996	939,2	3756,8
2772	894,4	3577,6	2997	939,4	3757,6
2773	894,6	3578,4	2998	939,6	3758,4
2774	894,8	3579,2	2999	939,8	3759,2
2775	895	3580	3000	940	3760
2776	895,2	3580,8	3001	940,2	3760,8
2777	895,4	3581,6	3002	940,4	3761,6
2778	895,6	3582,4	3003	940,6	3762,4
2779	895,8	3583,2	3004	940,8	3763,2

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2780	896	3584	3005	941	3764
2781	896,2	3584,8	3006	941,2	3764,8
2782	896,4	3585,6	3007	941,4	3765,6
2783	896,6	3586,4	3008	941,6	3766,4
2784	896,8	3587,2	3009	941,8	3767,2
2785	897	3588	3010	942	3768
2786	897,2	3588,8	3011	942,2	3768,8
2787	897,4	3589,6	3012	942,4	3769,6
2788	897,6	3590,4	3013	942,6	3770,4
2789	897,8	3591,2	3014	942,8	3771,2
2790	898	3592	3015	943	3772
2791	898,2	3592,8	3016	943,2	3772,8
2792	898,4	3593,6	3017	943,4	3773,6
2793	898,6	3594,4	3018	943,6	3774,4
2794	898,8	3595,2	3019	943,8	3775,2
2795	899	3596	3020	944	3776
2796	899,2	3596,8	3021	944,2	3776,8
2797	899,4	3597,6	3022	944,4	3777,6
2798	899,6	3598,4	3023	944,6	3778,4
2799	899,8	3599,2	3024	944,8	3779,2
2800	900	3600	3025	945	3780
2801	900,2	3600,8	3026	945,2	3780,8
2802	900,4	3601,6	3027	945,4	3781,6
2803	900,6	3602,4	3028	945,6	3782,4
2804	900,8	3603,2	3029	945,8	3783,2
2805	901	3604	3030	946	3784
2806	901,2	3604,8	3031	946,2	3784,8
2807	901,4	3605,6	3032	946,4	3785,6
2808	901,6	3606,4	3033	946,6	3786,4
2809	901,8	3607,2	3034	946,8	3787,2
2810	902	3608	3035	947	3788
2811	902,2	3608,8	3036	947,2	3788,8
2812	902,4	3609,6	3037	947,4	3789,6
2813	902,6	3610,4	3038	947,6	3790,4
2814	902,8	3611,2	3039	947,8	3791,2

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2815	903	3612	3040	948	3792
2816	903,2	3612,8	3041	948,2	3792,8
2817	903,4	3613,6	3042	948,4	3793,6
2818	903,6	3614,4	3043	948,6	3794,4
2819	903,8	3615,2	3044	948,8	3795,2
2820	904	3616	3045	949	3796
2821	904,2	3616,8	3046	949,2	3796,8
2822	904,4	3617,6	3047	949,4	3797,6
2823	904,6	3618,4	3048	949,6	3798,4
2824	904,8	3619,2	3049	949,8	3799,2
2825	905	3620	3050	950	3800
2826	905,2	3620,8	3051	950,2	3800,8
2827	905,4	3621,6	3052	950,4	3801,6
2828	905,6	3622,4	3053	950,6	3802,4
2829	905,8	3623,2	3054	950,8	3803,2
2830	906	3624	3055	951	3804
2831	906,2	3624,8	3056	951,2	3804,8
2832	906,4	3625,6	3057	951,4	3805,6
2833	906,6	3626,4	3058	951,6	3806,4
2834	906,8	3627,2	3059	951,8	3807,2
2835	907	3628	3060	952	3808
2836	907,2	3628,8	3061	952,2	3808,8
2837	907,4	3629,6	3062	952,4	3809,6
2838	907,6	3630,4	3063	952,6	3810,4
2839	907,8	3631,2	3064	952,8	3811,2
2840	908	3632	3065	953	3812
2841	908,2	3632,8	3066	953,2	3812,8
2842	908,4	3633,6	3067	953,4	3813,6
2843	908,6	3634,4	3068	953,6	3814,4
2844	908,8	3635,2	3069	953,8	3815,2
2845	909	3636	3070	954	3816
2846	909,2	3636,8	3071	954,2	3816,8
2847	909,4	3637,6	3072	954,4	3817,6
2848	909,6	3638,4	3073	954,6	3818,4
2849	909,8	3639,2	3074	954,8	3819,2

Uplink CH (TX)	Freq (MHz)	VCO (MHz)	Downlink CH (RX)	Freq (MHz)	VCO (MHz)
2850	910	3640	3075	955	3820
2851	910,2	3640,8	3076	955,2	3820,8
2852	910,4	3641,6	3077	955,4	3821,6
2853	910,6	3642,4	3078	955,6	3822,4
2854	910,8	3643,2	3079	955,8	3823,2
2855	911	3644	3080	956	3824
2856	911,2	3644,8	3081	956,2	3824,8
2857	911,4	3645,6	3082	956,4	3825,6
2858	911,6	3646,4	3083	956,6	3826,4
2859	911,8	3647,2	3084	956,8	3827,2
2860	912	3648	3085	957	3828
2861	912,2	3648,8	3086	957,2	3828,8
2862	912,4	3649,6	3087	957,4	3829,6
2863	912,6	3650,4	3088	957,6	3830,4

Glossary

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A/D-converter	Analogue-to-digital converter
ACI	Accessory Control Interface
ADC	Analogue-to-digital converter
ADSP	Application DPS (expected to run high level tasks)
AGC	Automatic gain control (maintains volume)
ALS	Ambient light sensor
AMSL	After Market Service Leader
ARM	Advanced RISC Machines
ARPU	Average revenue per user (per month or per year)
ASIC	Application Specific Integrated Circuit
ASIP	Application Specific Interface Protector
B2B	Board to board, connector between PWB and UI board
BA	Board Assembly
BB	Baseband
BC02	Bluetooth module made by CSR
BIQUAD	Bi-quadratic (type of filter function)
BSI	Battery Size Indicator
BT	Bluetooth
CBus	MCU controlled serial bus connected to UPP_WD2, UEME and Zocus
CCP	Compact Camera Port
CDMA	Code division multiple access
CDSP	Cellular DSP (expected to run at low levels)
CLDC	Connected limited device configuration
CMOS	Complimentary metal-oxide semiconductor circuit (low power consumption)
COF	Chip on Foil
COG	Chip on Glass
CPU	Central Processing Unit
CSD	Circuit-switched data
CSR	Cambridge silicon radio
CSTN	Colour Super Twisted Nematic
CTSI	Clock Timing Sleep and interrupt block of Tiku
CW	Continuous wave
D/A-converter	Digital-to-analogue converter
DAC	Digital-to-analogue converter
DBI	Digital Battery Interface
DBus	DSP controlled serial bus connected between UPP_WD2 and Helgo

DCT-4	Digital Core Technology
DMA	Direct memory access
DP	Data Package
DPLL	Digital Phase Locked Loop
DSP	Digital Signal Processor
DTM	Dual Transfer Mode
DtoS	Differential to Single ended
EDGE	Enhanced data rates for global/GSM evolution
EGSM	Extended GSM
EM	Energy management
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
ESD	Electrostatic discharge
FCI	Functional cover interface
FPS	Flash Programming Tool
FR	Full rate
FSTN	Film compensated super twisted nematic
GMSK	Gaussian Minimum Shift Keying
GND	Ground, conductive mass
GPIB	General-purpose interface bus
GPRS	General Packet Radio Service
GSM	Group Special Mobile/Global System for Mobile communication
HSDPA	High-speed downlink packet access
HF	Hands free
HFCM	Handsfree Common
HS	Handset
HSCSD	High speed circuit switched data (data transmission connection faster than GSM)
HW	Hardware
I/O	Input/Output
IBAT	Battery current
IC	Integrated circuit
ICHAR	Charger current
IF	Interface
IHF	Integrated hands free
IMEI	International Mobile Equipment Identity
IR	Infrared

IrDA	Infrared Data Association
ISA	Intelligent software architecture
JPEG/JPG	Joint Photographic Experts Group
LCD	Liquid Crystal Display
LDO	Low Drop Out
LED	Light-emitting diode
LPRF	Low Power Radio Frequency
MCU	Micro Controller Unit (microprocessor)
MCU	Multiport control unit
MIC, mic	Microphone
MIDP	Mobile Information Device Profile
MIN	Mobile identification number
MIPS	Million instructions per second
MMC	Multimedia card
MMS	Multimedia messaging service
MTP	Multipoint-to-point connection
NFC	Near field communication
NTC	Negative temperature coefficient, temperature sensitive resistor used as a temperature sensor
OMA	Object management architecture
OMAP	Operations, maintenance, and administration part
Opamp	Operational Amplifier
PA	Power amplifier
PDA	Pocket Data Application
PDA	Personal digital assistant
PDRAM	Program/Data RAM (on chip in Tiku)
Phoenix	Software tool of DCT4.x and BB5
PIM	Personal Information Management
PLL	Phase locked loop
PM	(Phone) Permanent memory
PUP	General Purpose IO (PIO), USARTS and Pulse Width Modulators
PURX	Power-up reset
PWB	Printed Wiring Board
PWM	Pulse width modulation
RC-filter	Resistance-Capacitance filter
RF	Radio Frequency

RF PopPort™	Reduced function PopPort™ interface
RFBUS	Serial control Bus For RF
RSK	Right Soft Key
RS-MMC	Reduced size Multimedia Card
RSS	Web content Syndication Format
RSSI	Receiving signal strength indicator
RST	Reset Switch
RTC	Real Time Clock (provides date and time)
RX	Radio Receiver
SARAM	Single Access RAM
SAW filter	Surface Acoustic Wave filter
SDRAM	Synchronous Dynamic Random Access Memory
SID	Security ID
SIM	Subscriber Identity Module
SMPS	Switched Mode Power Supply
SNR	Signal-to-noise ratio
SPR	Standard Product requirements
SRAM	Static random access memory
STI	Serial Trace Interface
SW	Software
SWIM	Subscriber/Wallet Identification Module
TCP/IP	Transmission control protocol/Internet protocol
TCXO	Temperature controlled Oscillator
Tiku	Finnish for Chip, Successor of the UPP
TX	Radio Transmitter
UART	Universal asynchronous receiver/transmitter
UEME	Universal Energy Management chip (Enhanced version)
UEMEK	See UEME
UI	User Interface
UPnP	Universal Plug and Play
UPP	Universal Phone Processor
UPP_WD2	Communicator version of DCT4 system ASIC
USB	Universal Serial Bus
VBAT	Battery voltage
VCHAR	Charger voltage
VCO	Voltage controlled oscillator

VCTCXO	Voltage Controlled Temperature Compensated Crystal Oscillator
VCXO	Voltage Controlled Crystal Oscillator
VF	View Finder
Vp-p	Peak-to-peak voltage
VSIM	SIM voltage
WAP	Wireless application protocol
WCDMA	Wideband code division multiple access
WD	Watchdog
WLAN	Wireless local area network
XHTML	Extensible hypertext markup language
Zocus	Current sensor (used to monitor the current flow to and from the battery)

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